the welding Engineer

ONEER BUSINESS AND TECHNICAL JOURNAL OF THE WELDING INDUSTRY

Volume XXIV October, 1939 Number 10

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OCTOBER, 1939

NO. 10

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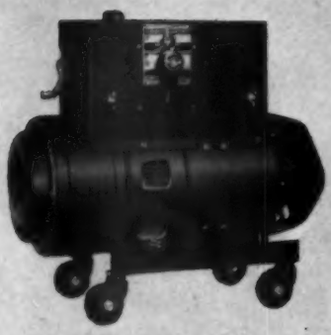

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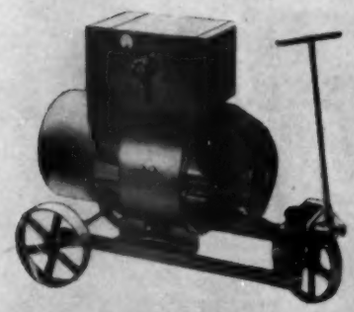

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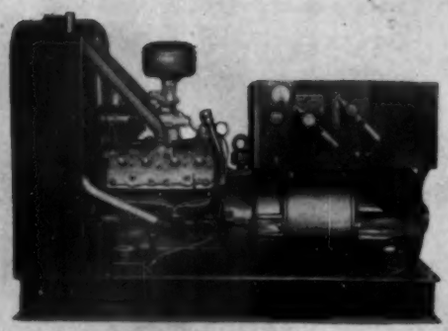

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Selling Welded Fabrication

A RECENT EXPERIENCE in talking to salesmen of automatic gas-fired furnaces for residential heating brings to mind rather forcibly the significant fact that in selling equipment, which is fabricated in part by welding, the salesmen fail to show any "welding consciousness." We found in talking to several representatives that these small furnaces can be divided into two distinctive classes depending upon the construction of the combustion chamber. Several of the leading manufacturers are using a welded low-alloy steel chamber which, of course, is absolutely leak-proof, while the others use a cast-iron construction. Those who are selling the cast-iron furnaces seem to lay a great deal of emphasis upon the superiority of cast-iron over steel in this particular application. However, as far as we can find out none of these alleged superiorities were more than talking points used by salesmen for the purpose of diverting the buyer's attention from the basic fundamentals. It was pointed out for example that cast-iron is supposed to be greatly superior to steel in corrosion resistance, but we failed to be convinced, because in the chemical industry many alloy steel vessels are giving excellent service.

What we are trying to point out here is that salesmen who are selling equipment which incorporates welded fabrication in an important element, in this case the combustion chamber, merely gloss over the fact that a welded construction is used. Emphasis is directed to the use of thin-wall steel as a better heat transfer medium than cast iron, but to our knowledge no mention is made of the maintenance free service which can be expected from a good welded structure, not overlooking also that a leak-proof unit is greatly superior to one which may leak and allow the products of combustion to enter into the heating air stream.

Who is to blame for this present condition? It seems to us that where welding gives one product a definite competitive advantage over another, that those of us in the welding industry should urge these manufacturers to capitalize fully on their welded construction. We realize, of course, that some of our leading industrial advertisers have been won over to this idea and are now featuring welded fabrication as a definite talking point. However, on equipment sold to Mr. Average Consumer, such as residential heating furnaces, there is a noticeable lack of "welding consciousness." This condition presents a challenge to the welding equipment industry to cooperate with customers so that they can do a better promotional job. At the same time they will boost their own interests and advance the use of welding.

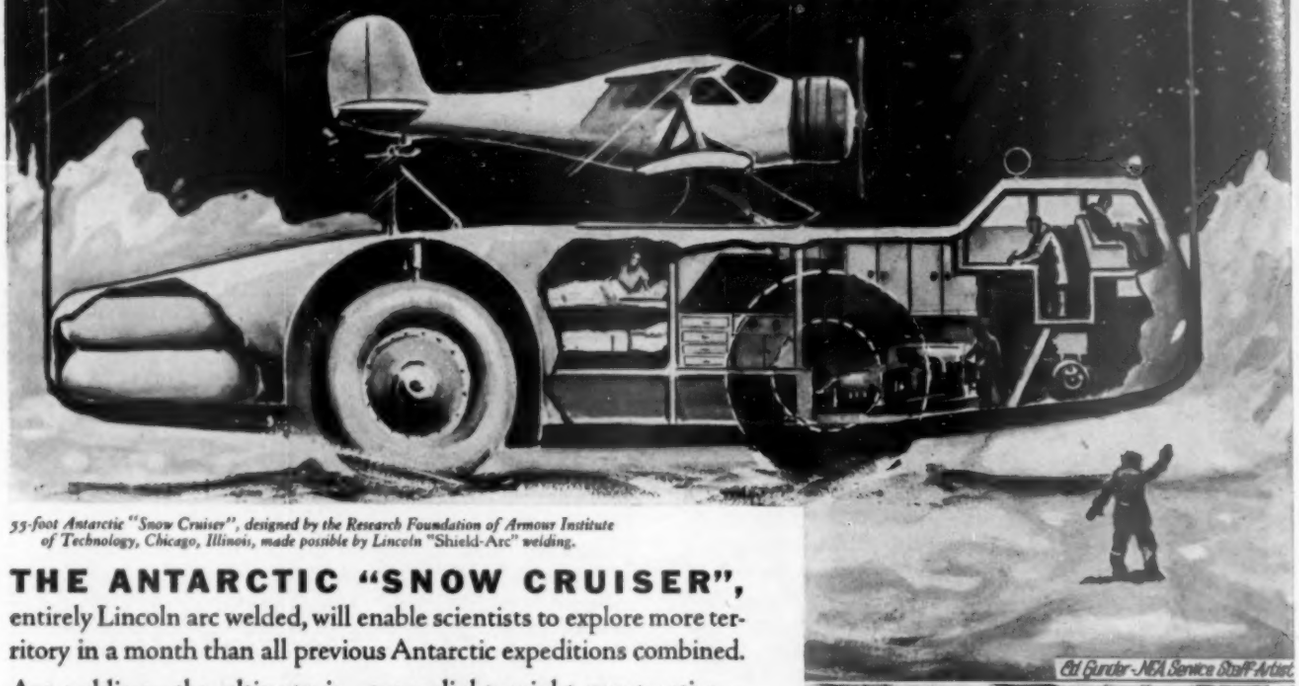
Redesign Opportunities

THE READER will find an article in this issue which sets forth very clearly some of the advantages which can be obtained by redesigning from cast steel to welded plate construction. Jonathan Jones, chief engineer of the fabricated steel construction division, Bethlehem Steel Co., describes the use of welded cable saddles on a recent bridge job. These welded structures represent the first departure from the use of steel castings, according to the author. These welded structures must support a total load of 10,800,000 lbs. each. It is quite significant, therefore, that this fabricator decided to use a welded design rather than steel castings, without even getting comparative estimates. There are several reasons for this. First, it is difficult to secure sound castings where the metal thickness varies radically from section to section. The pattern cost is high and the amount of money involved in a possible casting failure is too substantial to warrant taking the risk. In this case also the time element was important, and if a casting were rejected there would not be time enough to replace it and complete the construction schedule on time.

One of the most important factors affecting this particular decision was the difficulty of machining the cable trough. Considering a cast steel saddle, it was found that there was no boring mill available of sufficient height to accommodate these pieces in the correct machining position. By the use of welding it was possible to machine the cable trough before it was assembled into the structure and welded. Obviously very definite economies are possible when this can be done. There is also a substantial reduction in investment required in machine tool equipment. Many times this permits a shop to do a job with equipment already available and eliminates need of additional investment.

The reader will also notice that these heavy saddles were welded into a rigid structure with very little warpage by following the welding sequence described in detail by the author. In fact the warpage at the bottom of the base was much less than had been anticipated.

ANOTHER ACHIEVEMENT OF SCIENCE AND ENGINEERING MADE POSSIBLE BY LINCOLN ARC WELDING



55-foot Antarctic "Snow Cruiser", designed by the Research Foundation of Armour Institute of Technology, Chicago, Illinois, made possible by Lincoln "Shield-Arc" welding.

THE ANTARCTIC "SNOW CRUISER", entirely Lincoln arc welded, will enable scientists to explore more territory in a month than all previous Antarctic expeditions combined.

Arc welding—the ultimate in strong light-weight construction—made the "Cruiser's" 5000-mile exploring range possible. Conventional construction would have cut the cruising range 1 mile for every 2 pounds of added weight.

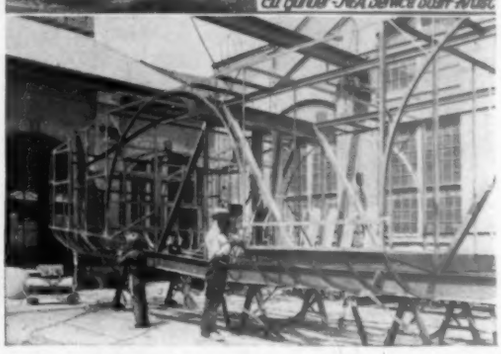
For least weight, greatest strength, utmost resistance to impact at sub-zero temperatures, "Snow Cruiser" construction required welding.

The builder used Lincoln *"Shield-Arc"* welders and electrodes exclusively.

ARC WELDING IN THE ANTARCTIC! Vital in the "Snow Cruiser's" construction, Lincoln *"Shield-Arc"* welding will safeguard the mammoth vehicle in the Antarctic. A Lincoln *"Shield-Arc"* welder and complete kit of Lincoln electrodes will be permanently aboard. All-purpose arc welding will stand ready to repair broken or worn parts, fabricate miscellaneous equipment, cut metal, charge batteries, and—in emergency—supply current for lights and machine shop power tools.

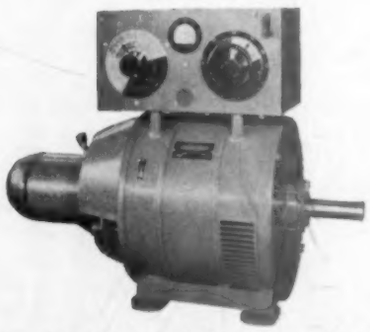
Lincoln *"Shield-Arc"* Welding Can Help You Too:— You may not build a "Snow Cruiser", nor put the arc in Ant-*ARC*-tic but you can benefit no end from *"Shield-Arc"* welding . . . Reduce weight, lick tough design problems, build better products, cut manufacturing costs, keep your plant in A-1 shape at lowest maintenance cost.

Find out about the benefits of "Shield-Arc" welding today. Consult your nearest Lincoln office or mail the coupon.



Ed Gunder-NEA Service Staff Artist

Arc Welders building the "Snow Cruiser" at The Pullman Standard Car Manufacturing Co., Chicago, Illinois.



Lincoln 200-ampere belt-driven arc welder permanently installed aboard the "Snow Cruiser" with complete kit of Lincoln electrodes.

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Fig. 38—All-welded earth-moving scraper and power control unit made from standard rolled steel shapes, bars and plates.

Engineering department control of the

Arc Welding Process

★ Part 3—Accurate templets needed for mechanical flame-cutting—Hydraulic presses and bending brakes reduce amount of welding needed—Pre-stressing will correct distortion

By WALTER J. BROOKING*
Engineering Department, R. G. Le Tourneau, Inc., Peoria, Ill.

If the shop is supplied with accurate, simple, complete drawings of the parts it has to produce; and if the engineering department will furnish accurate templets for all odd-shaped or cut parts to the shop, its job is to produce the parts correctly. The most important of all of the shop's tools are accurate prints and templets. If they have them, the rest of the job depends upon the skill of the workmen and the limitations of their equipment.

For making square cuts on shapes and bars on a mass production scale, a hacksaw can cut square with an accuracy of plus or minus 1/32 in. Square cutting of plate in shops equipped with shears depends only upon careful measurement and good clamping to avoid slipping as the blade shears the piece.

Irregular shapes can be cut accurately from plates by hand with the use of accurate templets and careful handling of the oxy-acetylene cutting torch. A multiple-torch, mechanical flame cutter such as shown in Fig. 30 cuts 3 pieces for nearly the cost of one and does a smoother job than can be done with a hand torch. Accurate templets and careful operation of the machine avoid bad fits. Occasionally the shape of the part is such that the heating incident to flame-cutting distorts it, in which case the use of the proper sequence of cutting may eliminate the trouble; or a hydraulic press, such as shown in Fig. 31, can be used to straighten the parts.

The use of a hand torch to make irregular cuts on angle iron, channels, pipes or beams is very effective, and can be accurately accomplished if good templets are available. An accuracy of 1/16 in. on each end can be expected, but at least 1/16 in. on each end should be allowed for a fit-up. A perfect metal to metal fit up is not obtainable by the flame-cutting method.

Parts which are cut to length and rolled or pressed round as the three bands shown in Fig. 32, an all-welded gear, must be cut to length accurately. The heavy small band in the foreground is the hub of the gear. It is pressed hot into the ring shape in the hydraulic press and the seam is welded. If it is cut short it won't clean up when machined. The small ring leaning on the gear band is a good example of the fabrication of a small ring by roll-

*First section of author's article was published in August, 1939 issue, pages 19-21. Second section was published in September, 1939 issue, pages 29-33.

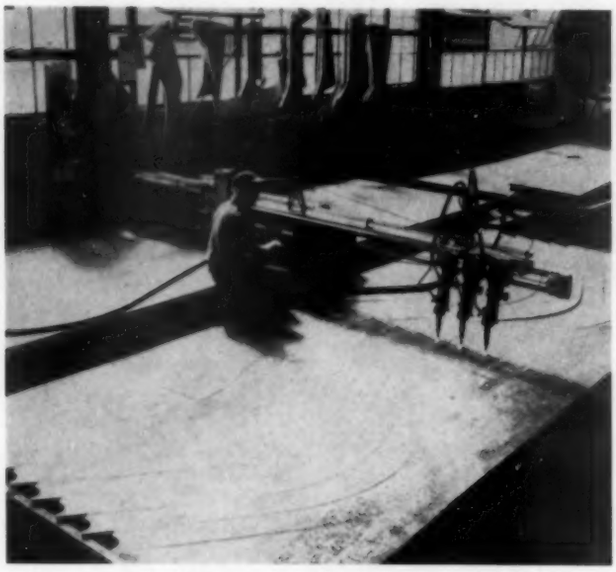

Fig. 30—A triple torch mechanical flame-cutting machine which cuts three pieces from a plate at one time.

ing a bar into a ring and welding the ring.

The wide disc of the gear shown in Fig. 32 is regularly made from a piece of scrap left from another piece of equipment. The center is punched out in the punch press and the disc itself then cut out with a mechanical flame-cutting torch. Care must be taken to keep the outer diameter concentric with the inside diameter.

One very effective method of shaping parts is by pressing them, either hot or cold, in a hydraulic press. The method has some features about it which result in bad fits at times. Worn dies may cause enough variation in the parts to require special fitting of parts which join the pressed part. Figure 33, which shows the component parts and one view of a finished, but unmachined cable reduction sheave wheel, shows a large main plate which is pressed hot in one draw in the 500-ton hydraulic press shown in Fig. 31. Wear on the die, temperature variations at the time of pressing, and variations in thickness of mill-run rolled plate cause enough variation in some of the plates to necessitate trimming of one or more of the four curve-sided gussets (used as spokes) lying on the floor. Careful regulation of the temperature of pressing and careful use of the die will reduce this variation to a minimum however, and the strong, light weight, high quality finished product shown in Fig. 34 can be produced at a profit.

Fig. 31—A 500-ton capacity all-welded hydraulic press used for mass production forming of parts to be unified by welding.

A bending brake can eliminate large amounts of welding by bending one piece to a shape, instead of using two flat plates welded together at the desired angle. If the bends are not made accurately, however, the resulting gap, overlaps, or other irregular fit-ups may be costly. The care exercised in bending parts is the factor which determines the accuracy of fit-up.

In all of the cutting and shaping of parts for welding, if the machinery and tools used by the workman are in good condition, the human element is the important factor. The care exercised by the man who cuts or processes the parts strongly influences the profit or loss on the job.

One of the elastic features of the arc welding method of manufacture is that many parts can be partially or completely machined before being welded into the complete structure. Careful layouts and accurate drilling, boring, turning, or other machining processes reduce occurrence of bad fits to a minimum. Drilling jigs which automatically locate the holes in a piece from the correct points of reference help to cut costs and prevet bad fits which necessitate extra work or even scraping of the parts.

Fig. 32—A 13 in. all-welded gear showing the welded blank and its component parts.

The actual setting up and welding of parts on a mass production scale involves a very important problem—that of accurately placing the parts in relation to one another and holding them there during welding. It has been found that parts which are cut perfectly and fit properly may be put together in such a manner that the resulting structures are useless or must be reworked in some way. Fixtures can usually be made in which parts can be placed easily, clamped in place and tack welded together with no measuring and a minimum of study or adjustment. The simpler and nearer fool-proof the set up fixture can be made, the cheaper the production of parts will be, because the parts will automatically be brought into their correct relationships.

Bad Fits Due to Welding

The great heat of the electric arc often causes a warping and distortion of structures during fabrication. There are many ways of combatting such distortion, and some study of the structure in the experimental stage will usually yield information which can be used to avoid excessive distortion.

Fig. 33 — Component parts and the finished structure, an all-welded cable reduction sheave wheel. Careful cutting and processing and accurate fitting are essential to profitable production of this type of structure, because of the many curved parts.

One method which is cheap and very effective is demonstrated by the plate which is leaning on the square in Fig. 35. The same plate is shown welded into a structure, with the plate setting parallel to the one leaning on the square. A bend of ⅛ in., shown as an offset by the square's straight-edge is pressed into the plates before welding. The draw from the welding is enough to straighten the plate, as shown in the illustration, so that the entire front surface of the plate can be faced off in a lathe with removal of very little metal.

The same method, applied on a larger scale is shown in Fig. 36. The main side structure of an earth-moving unit is shown on the fixture in which it is set up and welded. The curve in the main beams of the fixture represents the degrees of bow which the welding of the structure will produce. The parts are clamped to the fixture by means of about 10 clamps such as the one shown. The frame of the fixture is strong enough so that when the structure is welded, the bow in the fixture remains the same. When the clamps are released, the structure comes out almost straight, as is shown by the one in the illustration. (The clamp is loose, and the distance from bottom edge of structure to top of square bars on fixture represents approximately the amount of distortion which welding would cause.)

The hydraulic jack press, mounted on a rolling frame on a rigid steel bed plate shown in Fig. 37 is another very effective device which can be used to press large parts into shape if they are distorted from welding. The picture shows a side structure such as is shown in Fig. 36, ready to be pressed. A hydraulic press serves the same purpose for smaller parts.

The effect of bad fits on a control naturally depends upon the amount of irregularity in the fit-up. The engineering department must put symbols on the prints which cover the normal

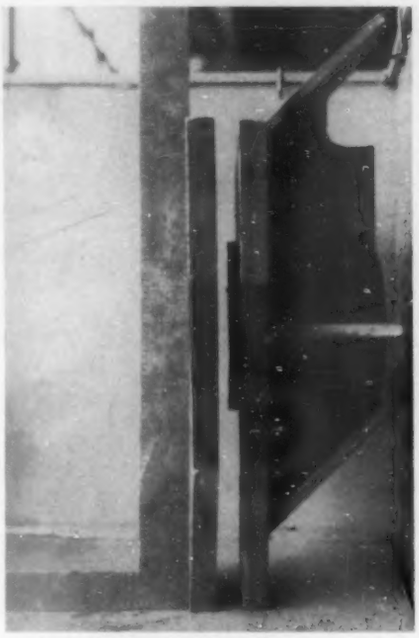

Fig. 35—The ⅛ inch offset pressed in the plate leaning against the straight edge is drawn out by the welding, leaving the plate on the completed structure (shown beside the bent plant) straight and flat for machining after welding.

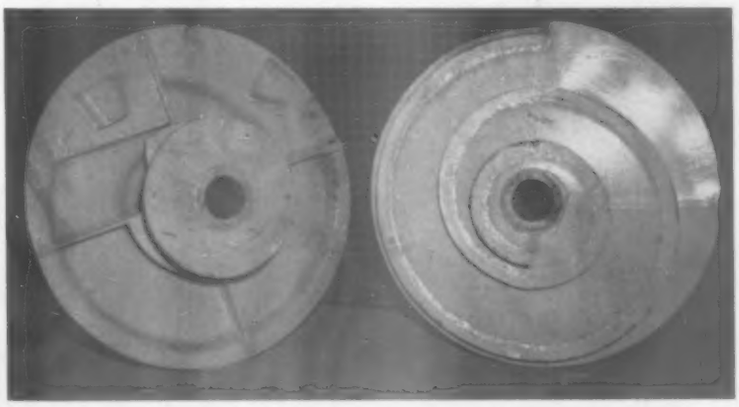

Fig. 34—Front and back view of completed cable reduction sheave wheel shown in Fig. 33.

fit up, and the extra work involved in using badly fitting parts on each job becomes a problem for the judgment of a representative of the engineering department or a trained shop man. In either case, the relative number of bad fits per order of equipment should be small, so that the control of the irregularities becomes a relatively small matter. Each badly fitting set of parts should be studied and the cause for the bad fits eliminated in the prints or system of production of the parts, so that the future orders of the same equip-

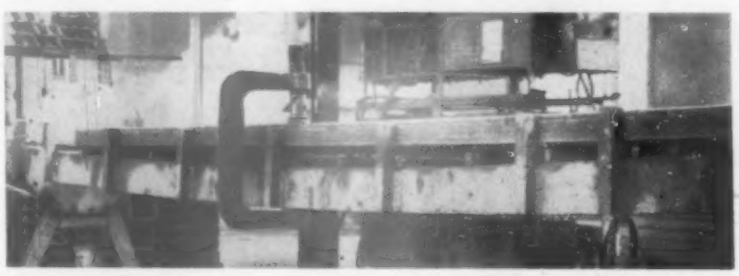

Fig. 36—The curve in the beams of the fixture is about equal to the draw of the welding on the structure. The large clamp is loose, and the structure, which is finished, is nearly straight, though it was bowed to match the fixture during welding.

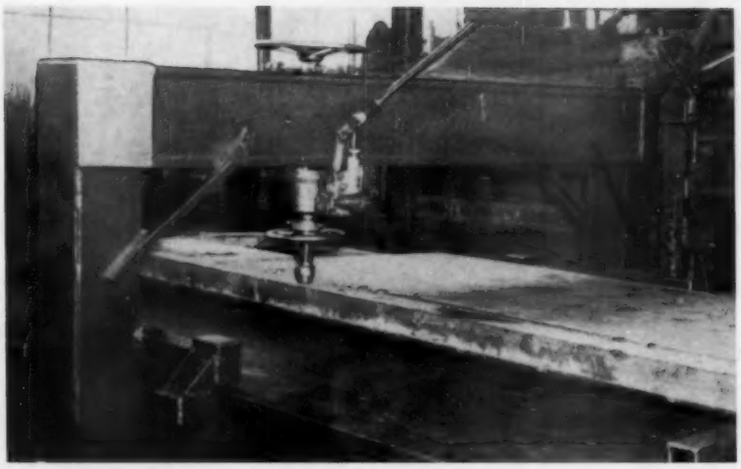

Fig. 37—A hydraulic jack press mounted on a frame which can be centered over any part of a face plate, used in removing distortion caused by welding on large flat structures.

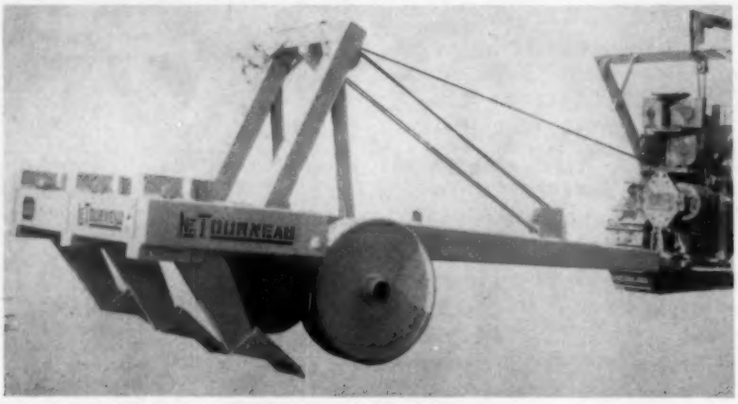

Fig. 40—A "rooter"—all-welded unit for breaking up the top 2 feet of surface for earth moving. The power take-off unit on the tractor is also completely arc welded.

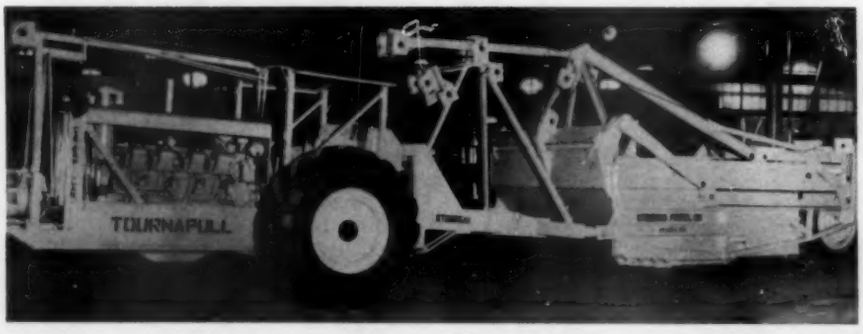

Fig. 41—An all-welded 30 cu. yd. capacity scraper and a tractor whose transmission, frame, cab and accessories are arc welded.

ment are free from that particular bad fit.

The proof of the effectiveness of the control of welding by the engineering department is to be seen in examples of all welded machines shown in Fig. 38 to Fig. 41 inclusive. Figure 38 is a tractor drawn earth-moving unit powered by an all-welded power control unit. Figure 39 is a 40-ft. all-welded tractor crane shown carrying an all-welded scraper. Figure 40 is an all-welded "rooter" used for breaking and tearing up the surface of the ground to a depth of over two feet. Figure 41 is a 30-yd. capacity all-welded earth-mover drawn by a tractor, whose transmission, wheels, cab, frame and accessories are of all-welded construction. All of the illustrations show the great freedom of design which is possible with welded construction, and yet all have been profitably produced and are on the competitive market today. The accurate control exercised from the engineering department during production of these units plays an important part in their profitable manufacture, because it replaces all guesswork and rule-of-thumb procedure with complete specifications for all processes. The result is a uniform product, standardized throughout, incorporating the best materials, finest workmanship, highest quality and attractive appearance with the lowest cost. This is the essence of modern manufacture.

Fig. 39.—An all-welded 40 ft. tractor crane in the process of moving an all-welded scraper.

» «

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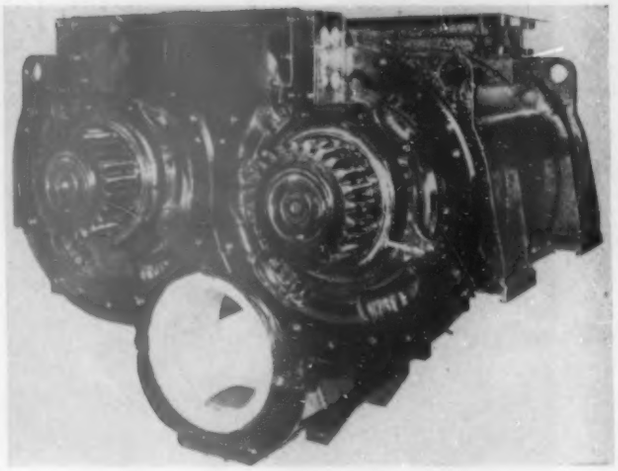
Welded steam-jacketed mixing kettles with agitator mechanisms. Photo (Leader Iron Works, Decatur, Ill.).



A "twin motor" for electric locomotive drive with fabricated frame.

Economy and light weight achieved by arc welding

Railway Motor Frames

★ Twin motors for Pennsylvania Railroad's newest electric locomotives fabricated by arc welding—Weight reduced to 12 lbs. per hp.

By L. D. JENNINGS
Manufacturing Engineer, Generator Works Dept., Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

BECAUSE THEY OFFERED ingenuity of design, ease of fabrication and high strength from low cost structural plate, arc-welded structures were adopted for the 770-hp. twin motors driving the Pennsylvania Railroad's newest giant locomotives. This fabricated construction eliminated expensive forgings, dies and patterns and helped to reduce weight to 12 lbs. per hp.

Included in the arc-welded fabrication were the motor frame, the quill bearing cap, the end housings, the rocker ring on which the brush-holders are mounted, the drive quill and the gear case of each compact, high-rating motor.

The frame is composed of 115 individual items, sheared or flame cut from structural steel, assembled and then arc-welded to form a homogenous structure. The body of the frame (Fig. 1) is made from two rolled cylinders or barrels which are fastened to the spectacle shaped ends by means of tongues on the cylinders. The tongues fit in

Fig. 1—Fabricated arc-welded twin motor frame.

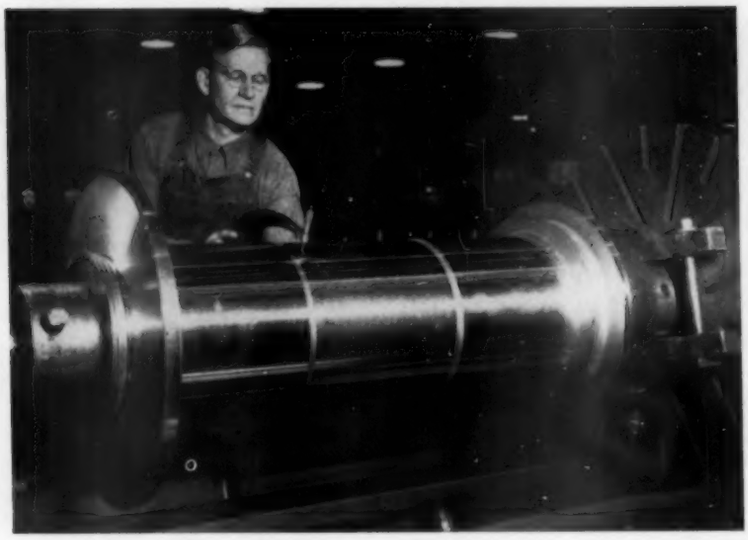


Fig. 2—Drive quill fabricated by arc-welding from pre-formed plate.

machined grooves of the inner faces of the ends. These ends are flame cut, two at a time, using a magnetic template to guide the follower of an oxy-hydrogen cutting machine. The braces for the frame supports are cut in a similar manner. This method of preparing irregular shaped details is most satisfactory, in that several pieces of one item may be cut simultaneously and the pieces flame-cut from a given template are identical; thus considerable saving is realized by multiple cutting and the assembly is simplified with accurately cut details.

A welding fixture is employed to assemble the frame. An end plate is placed face down on centering plugs in the fixture. The rolled barrels are put upright in machined grooves of this plate. The other end plate, with similar grooves in its inner surface, is fitted to the opposite end of the cylinders. The remaining parts are readily placed with the aid of locating pins and blocks.

The complete assembly is tacked together and then placed on a welding manipulator and welded. All the welding is done in a down-hand position with the aid of the manipulator. Heavy coated 3/16- and ¼-in. down-hand welding electrodes are used. Outside welds are ⅜-in. fillets applied in one pass with ¼-in. electrodes, and inner supporting bars are fastened with single pass ¼-in. fillet welds deposited with 3/16-in. electrodes. Use of a welding fixture decreased the assembly time 60 per cent under a "square and scale" method of assembly, and the manipulator equipment decreased the welding time 20 per cent.

Power is transmitted from the twin rotors of each frame to the locomotive drive wheel by means of a hollow cylinder with a heavy flange at each end commonly called a quill (Fig. 2). Because it acts as a drive shaft, rotating in bronze bearings with the flanges serving as thrust collars, the fillet weld in the corner must have a polished surface absolutely free of defects.

Fig. 4—Automatic welding of fabricated end housings.

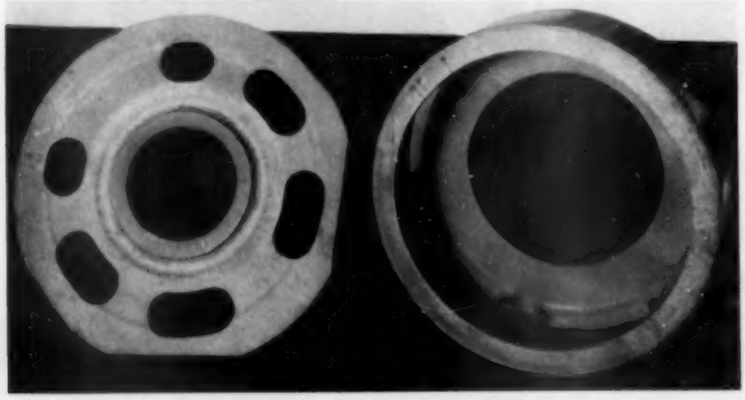


Fig. 3—Fabricated end housing and rocker ring for twin motor.

Formerly, quills were made of seamless tubing, or forgings, but it was found that a quill could be manufactured more economically by arc-welding. The body of the quill, partially rolled from structural steel plate 1⅛-in. thick, is made into a cylinder by hot pressing with a forming die. A 40-deg. U-type weld preparation is milled at the longitudinal parting seam and welded solid with heavy coated ¼-in. welding electrodes.

The flanges are flame cut—two at a time—from steel plate, rough-bored and shrunk upon the rough machined quill body. A vee weld is made at the ends of the quill to join the outside of the flanges to the quill body. A vee is then machined where the inner face of the flanges joins the outer surface of the barrel. This assembly is placed on a 45-deg. rotating table, flange down,

so that the latter vee can be filled with weld metal. The weldment must be free of any surface holes when it has been machined and polished. Proper choice of welding electrodes, correct welding technique, and suitable equipment make it possible to produce a quill of high quality, considerably cheaper than the forged type.

The end housings (Fig. 3) previously were made from rolled forgings. Arc-welding is now more economical. Each fabricated housing is made from a disc ¾-in. thick, a 3-in. hub, and a rolled ring of 1-in. square cross-section, all welded together. The discs are flame cut and are given the required contour in a large hydraulic press with a special forming die. The hubs are flame cut and rough turned to facilitate the assembly of the disc to the hub. This assembly, together with the ring, is placed on a welding manipulator and welded automatically with ¼-in. shielded wire (Fig. 4). All welds are ⅜-in. single pass. Automatic welding reduced the welding time compared to hand welding 37 per cent.

» «

Welded Air Chambers For Chicago Subway

★ In connection with the building of Chicago's new subway, it was necessary to provide emergency air chambers, located above ground at intervals of ¼ mile. These are for the purpose of emergency exits in case a fire, explosion, or a cave-in should develop in the subway tube during construction. In other words, an accident of some nature might block the working entrance and the tunnel diggers would be trapped in the tube. As shown in Fig. 1 an emergency air chamber is built by bolting 13 welded sections together, using a heavy rubber gasket between sections. In addition to the door frame at the end of the chamber there are two intermediate door frames inside so that workmen can make their escape, without release of underground air pressure. In leaving the tunnel, the men enter an intermediate chamber and close an air door, before entering the chamber immediately adjacent to the exterior door.

One Longitudinal Seam

The individual sections were fabricated by welding ⅜ in. plate 48 in. in width to form cylinders 5 ft. in diameter. Only one longitudinal seam was employed. For purpose of reinforcement, three circularly bent angles were used as stiffener rings, one in the middle and one at each end of the section. These end angles were provided with 57 bolt holes, ⅝ in. diameter. Construction views are shown in Fig. 2 and Fig. 3, which were taken in the shop of Western Welding & Boiler Repair Co., 1432 W. Lake St., Chicago, who built these chambers for the Chicago subway project.

Fig. 2—One of the welded sections which will have a door frame bolted to it. These doors permit tunnel workers to escape in an emergency, without releasing air pressure in the tunnel.

Fig. 1—Emergency air chamber for protection of tunnel workers on on State St. subway. A total of 13 welded sections are bolted together.

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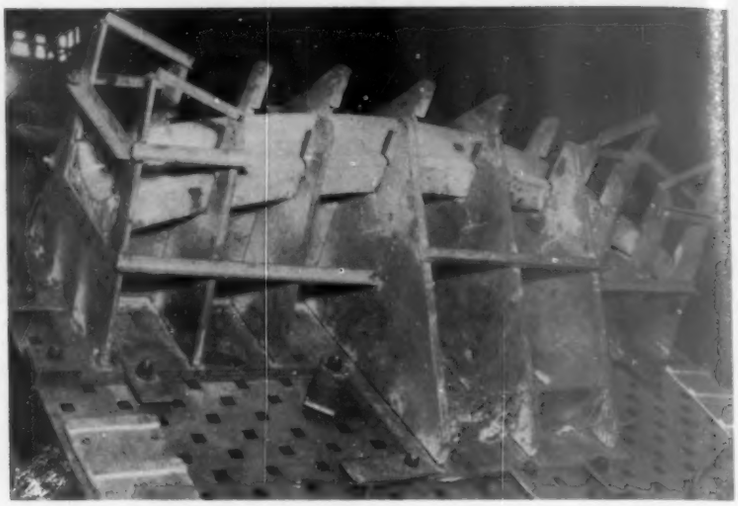


Cable saddle fitted up for welding of ribs, trough slab and base plates. Photo (Bethlehem Steel Co.).

New Tacoma Narrows bridge uses

Welded Cable Saddles

★ Details of design and shop fabrication of heavy welded structures which will sustain cable loads of 10,800,000 lbs. each

By JONATHAN JONES

Chief Engineer, Fabricated Steel Construction Division, Bethlehem Steel Co., Bethlehem, Pa.

IT IS BELIEVED that the cable saddles of the Tacoma Narrows Bridge (Washington) represent the first departure in the United States from the use of steel castings, and the first use of welded structural plate, for these heavy and rather complicated pieces.

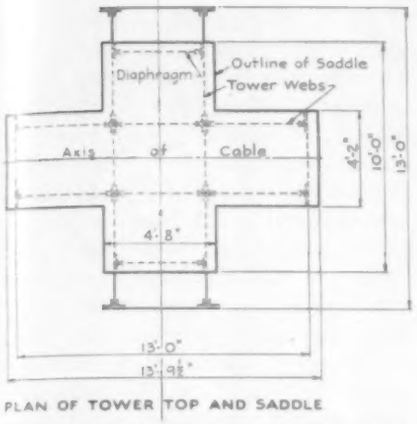
This is a highway bridge of 2800 ft. span, carrying a 24 ft. wide reinforced concrete roadway slab, and it requires two parallel-wire cables of 17 in. diameter each. The vertical reaction of each cable upon its saddle, from dead and live loads, is 10,800,000 lbs. Each cable is to be spun in 19 strands, and each strand will be spun outside the saddle and transferred into it when completed. As on the Golden Gate Bridge, a cross section of the cable, before compacting, will show the 19 strands in a hexagon with its apieces up and down. The hexagon will however not be quite regular, as measures will be taken to so place the strands that the compacting into a circle will require less displacement of wires than in the case of a true hexagon. This feature accounts for the novel shape of the cable trough, in the saddle, as shown in the cross section Fig. 2.

One of the major problems in the saddle design was the transfer of each cable load to all principal elements of its tower leg. The tower legs are cruciform, four square steel shafts being assembled to form a cross of five cell spaces, as shown in Fig. 1. The width over the tower web plates, transversely of the bridge is 13 ft. 1½ in., of which 3 ft. 6 in. is the width of the central cell.

At one stage it was proposed to make the saddle a casting 3½ ft. in width, or as wide as the central cell, and to load the remainder of the column top by means of a transverse grillage. This grillage, however, was difficult to design in any reasonable depth, since its deformation would defeat the purpose of fully loading the outermost column webs. A saddle with ribs extending out 5 ft. 10 in. to each side proved too deep and heavy to be practical.

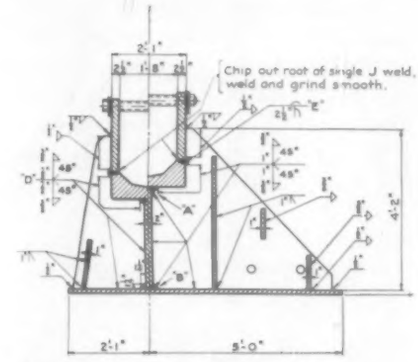
A compromise was adopted, whereby the saddle width was made 10 ft., leaving part of the two lateral column cells not covered. Deep diaphragms built into these cells, at the extremities of the saddle, served to distribute satisfactorily over the remainder of the column material.

This determined a saddle cruciform in plan, 10 ft. wide over the central



PLAN OF TOWER TOP AND SADDLE

Fig. 1—Plan of tower top showing the outline of the cable saddle and how it is placed to distribute the load.



HALF SECTION B-B HALF SECTION A-A

Fig. 2—Cross-sections of welded cable saddle. Note use of A.W.S. weld symbols to control shop welding.

third of its length and 4 ft. 2 in. wide fore and aft. The 10 ft. width necessitated a depth of slightly over 3 ft. from bottom of cable trough to under side of saddle. The saddle length of 13 ft. 9½ in. conformed to the tower design and gave a satisfactory bearing pressure for the cable wire in the saddle trough.

Reasons for Welding

At this stage the decision was made, without making comparative cost estimates, to weld these saddles instead of casting them. There were several valid reasons. The metal is of radically varying thicknesses, which on other bridges has made it difficult to secure sound castings. The pattern is costly. The amount of money tied up in the chance of losing a casting through mishaps is very large. The time element seemed to favor the weldment. And finally, if one casting should be rejected, the time required to replace it would wreck the schedule for completion of the bridge.

Another factor would have interfered with the use of castings, but could be overcome in the case of weldments, namely the machining of the cable trough. It has been customary to set the castings on a side in a boring mill and sweep them on a circular arc past a fixed tool stand. At the time this bridge was fabricated there was no boring mill known to be available that had sufficient height to accommodate these 10 ft. wide pieces in the upended position. This fact not only eliminated castings of the adopted cruciform shape, but it had a major influence on the welding procedure.

In the cross-section, Fig. 2, the elevation, Fig. 3, and the plan, Fig. 4, all details and all dimensions have been eliminated except those defining the main elements of the piece and the main welds. All covers, gaskets, end hoods, beacon supports, and hand-rope attachments, have been eliminated as not pertinent to the present description. The sequence of manufacture was as follows:

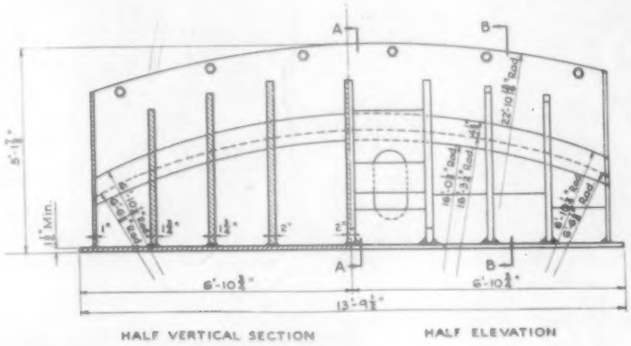
1. The cable trough rolled slab 8 in. thick was curved at a low red heat to the 16 ft. radius under a 7000-ton hydraulic bending press.

2. The 2 in. vertical stem piece was machine flame cut at its upper edge both for radius and for double vee bevel, the depth being over-size.

3. The stem was welded to the underside of the trough slab (weld A) with a full reinforced butt weld.

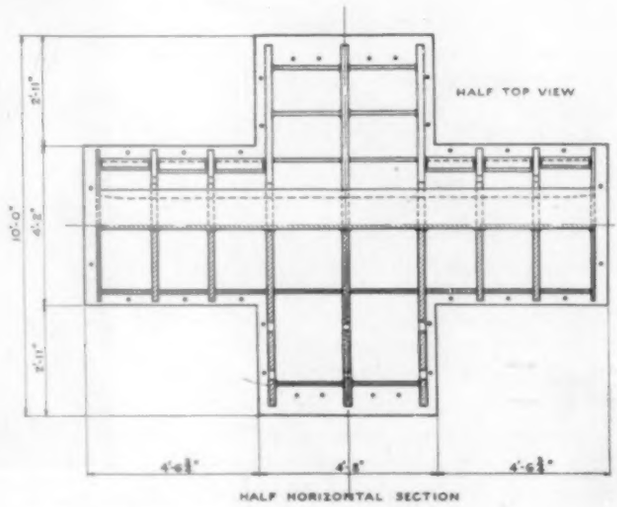
4. The T-section thus formed was rough-machined for the slab sides and the cable trough. For this operation, the four T's were up-ended so that the trough and the stem piece lay in a horizontal plane, and were mounted inside the track of a floor-type boring and facing mill ordinarily used for machining tunnel lining segments. A tool carriage traveling 360 deg. on the circular track then cut the external circular work on the four trough slabs.

5. The T-sections were then stress-relieved. The maximum change of dimension found to result from this treatment was 1/16 in. This was the only stress-relief given to any part of these saddles. For weldments of such size a final stress-relief would seem to some designers to be advisable; stress-relieving would however have carried with at a final machining to accurate dimensions, and this, for the reason state above, could not be accomplished on any available equipment. It is however believed to be the consensus of opinion that for the nature of service to be performed by these saddles, a general stress-relief is not important. What is important, is



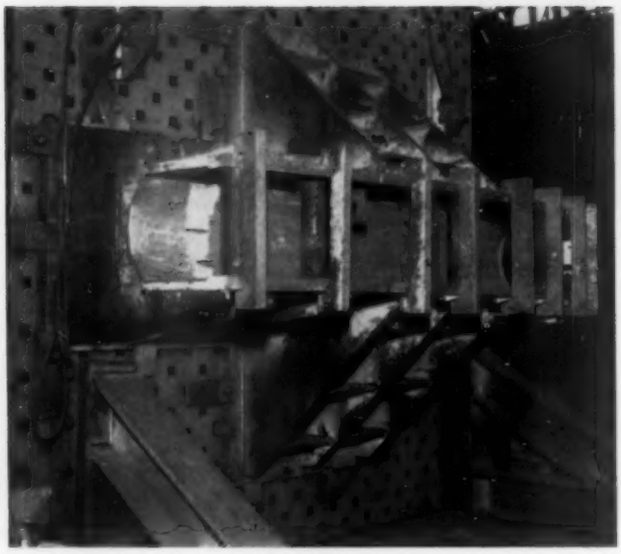
HALF VERTICAL SECTION HALF ELEVATION

Fig. 3 — Half vertical section and half elevation of cable saddle.



HALF HORIZONTAL SECTION

Fig. 4—Half top view and half horizontal section of saddle.



Cable saddle positioned on face plate for downhand welding of trough side plates. Photo (Bethlehem Steel Co.).

that the dimensions of the trough, once established, be not greatly warped by subsequent welding.

6. The T-sections were taken back to the boring mill and given their final machining. This was somewhat exacting, as at each end of the circular arc there are run-off curves of shorter radius, not shown in Fig. 3, producing a flare in the horizontal as well as the vertical plane. This final machining included the grooves for the side welds E.

7. The bottom edge of the stem piece was machine flame-cut and double-vee beveled for the full butt weld to the base plate (Weld B).

8. The 1½ in. base plate (10 ft. x 13 ft. 9½ in.) was ordered 2 in. thick to allow ½ in. for a final bottom cut. This also permitted waste from base plate to be used for some of the 2 in. thick bracket plates. The base plate was furnished flattened at the mill and was not pre-machined before assembly.

This plate was solidly bolted down (in the shop) to a 10 ft. x 15 ft. x 9½ in. cast steel surface plate weighing about 44,000 lbs. which in turn was mounted on a trunnion device for positioning the welding.

9. The pre-assembled T of cable groove and stem piece was mounted on the base plate and tacked. All transverse bracket plates, 9 on each side, were flame-tailored to fit around the T in the right relationship, and with the proper groove, for welds D; also along the base slab.

These were, it will be noted, full tee butt welds with reinforcement. In the case of the wider brackets reaching out to the 10 ft. width, horizontal shear is developed between bracket and base of an intensity requiring this full butt weld; for the narrower brackets the computations indicated that fillets would suffice, but butts were used to keep all joints of the highest standard. At this stage of erection, the vertical 2½ in. side plates enclosing the trough were not placed; the uppermost part of the bracket plates was purposely shaped to extend somewhat into the space which these side plates would later occupy.

10. Welding was now commenced at the bottom and brought up toward the trough, to minimize pulls on the latter. Welds were positioned, and flat position, high-heat electrodes used. Most of the heavy welds were made in step-back sequence, the full number of passes being built up in short lengths with intervening gaps for later closure. The resulting assembly showed no distortion of the machined cable groove.

11. A cutting torch on a track next cut the upper ends of the side bracket plates to the exact vertical plane of the outside face of the 2½ in. vertical side plates.

12. The side plates were then tacked in place and welded. They were heavily braced across, and were also supported by the tops of the side brackets. Because this was a 2½ in. unsymmetrical weld (Weld E), it was the one considered most apt to produce unmanageable warpage; the maximum variation across the tops of the side plates was, however, the negligible amount of ⅛ in. The cover plate, not shown in the figures, was tap-screwed in place without difficulty from this warpage.

13. The final assembly operation was to insert between the transverse bracket plates, the longitudinal stiffening plates, and to connect them with fillet welds. These end fillets, being of 1 in. leg, exerted considerable pull; and at the top of the wide brackets they pulled the latter in very slightly, this being the only spot in the entire assemblage where any warpage was observable by the naked eye.

14. The warpage of the bottom of the base slab was much less than had been allowed for, and a 3/16 in. cut brought all into a plane. The extra 5/16 in. of height is negligible on top of a 450 ft. tower.

The width of 10 ft. interfered somewhat with the intended positions of the temporary footwalk ropes for cable construction. These were therefore threaded through holes in the side brackets, and coupling sockets cast in place before the saddles were shipped.

The design of these saddles was worked out by close co-operation between the Washington Toll Bridge Au-

Close-up showing "single J" welding grooves for trough side plates. Photo (Bethlehem Steel Co.).

thority, through Clark H. Eldridge, its bridge engineer, and the engineering and manufacturing departments of Bethlehem Steel Co. For structures such as these there cannot be a design until there is a determinate manufacturing practice and welding sequence; these were mutually adjusted to give an entirely satisfactory product.

These saddles were made in the Welded Products Shop of our company at Bethlehem, Pa. The finished weldments weighed 15 tons each as shipped. The first pair were shipped in three months after the general principles of the design and process were established firmly enough to order the rolled material from the mill.

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Anvil Base For 60-Ton Forging Hammer Rebuilt By Gas Welding

By J. H. ZOOG*

★ A really "hot" job of welding was involved in the repair of a heavy cast-iron anvil base for a 60-ton forging hammer in a Pittsburgh steel plant. Three men were required to do the oxy-acetylene welding and to maintain the big casting at the pre-heating temperature. Each operator was relieved at 10 min. intervals, because of the tremendous amount of heat radiated from the heavy base and the welding torches. It required 15 hrs. of continuous welding to complete the job.

Size of Anvil Base

This heavy anvil base was 10 ft. high, 5 ft. wide and 40 in. deep at the top. The dovetailing groove was tapered from front to back, to permit use of tapered keys. This allowed several sizes of anvils to be inserted into the groove.

Examination of the broken ledge disclosed that it had cracked clear across the top approximately 40 in. long and to a depth of about 4 in. An attempt had been made to repair the casting by studding and arc welding, but these repairs did not stand up in service. When permission was obtained from the works manager to attempt the repair of the anvil base by oxy-acetylene welding, it was necessary for us to chip out the previous arc welded deposits in order to reach solid metal. The huge casting was then preheated, using natural gas. It was necessary to heat the casting for 24 hrs. in order to soak heat into the center of the huge base and produce a condition favorable to the maintenance of a high temperature in the vicinity of the welding area.

Type of Equipment Used

Three welding torches with 12 in. extensions (Airco Style 9800 with Style 4—2 Flame No. 10 Tips) were employed on this repair job. Two men welded at one time, while the third man used his oxy-acetylene torch to maintain the preheating temperature.

Fig. 2—Cylinders were manifolded for oxygen and acetylene. Total oxygen used—4400 cu. ft.; total acetylene used—4250 cu. ft. Photo (Airco).

Fig. 1—Welding crew at work on anvil base. This job required 15 hrs. of continuous welding. Photo (Airco).

The importance of getting a good heat into the casting, before any weld metal was deposited, can hardly be over-emphasized. In this case we played the three Style 9800 torches on the top of the casting, or area where the weld metal was to be deposited for nearly half an hour before any weld metal was laid down. If this precaution had not been taken, the first layer of weld metal would likely have been very hard and brittle from the chilling effect of the base metal. In other words, it was necessary that the casting be brought up to a red heat for at least four to six inches from the actual

*Applied Engineering Department Air Reduction Sales Co., Pittsburgh, Pa.

welding area to prevent this chilling effect.

Three-cylinder manifolds were used for the acetylene supply, and five-cylinder manifolds for the oxygen cylinders. The metal deposited to build up the broken dovetail ledge was 250 lbs. of Airco 3/8-in. No. 10 moly-nickel cast-iron rods. Atlas flux used was 11 lbs. The time for welding was 15 hours each for 6 welders and 2 helpers. Oxygen consumed was 4400 cu. ft., and acetylene, 4250 cu. ft.

Economic Savings

A new anvil base casting would have cost $3600, plus $1400, the estimated cost of removing the old casting from its concrete base. In addition it would have been necessary to resort to a special crane to install a new base casting of this size, which additional cost was estimated at $1200, making a total cost of $6200. Subtracting an estimated scrap value of $600 for the cracked anvil base, we estimated that the net cost of a new casting would have been $5600. The broken casting was repaired at a cost for labor and materials which was but a fraction of the cost of a new piece.

Some Practical Suggestions For the Job Shop Owner

By DAN E. RANDALL*

★ A job shop should establish a minimum price and stick to it. Some shops have a 50 cent minimum while others have none at all. For a shop doing most of its work with the arc a 35 cent minimum is a fair one to both customer and shop owner. If the job is so small as to come under that price it is good business to make your customer a present of it. You will get its value back in good will many times over. Costs, plus wages, plus a fair profit make a good business, which will also return a profit to your customer.

The men employed by a commercial job shop can either be its greatest asset or a liability. In the first place they must be thoroughly competent workment both with oxy-acetylene and electric arc. They must be equally at home welding white metal with the torch or welding stainless steel with the arc. If the proprietor sends them out on a job, they must be able to weld a pipe, a boiler, flue, a gear tooth, or a cast-iron boiner section. It is often their duty to meet the customer, so a pleasing personality and courteous manner should be one of the qualifications insisted upon when hiring an operator.

*Welding Shop Proprietor, La Crosse, Wis.

Sobriety and Honesty

The facility for close estimation should be another qualification as well as two old standbys—sobriety and honesty. The average welding operator having all of these qualifications would certainly be a "star" among his fellows. However, a job shop owner who can handle men can take a foundation of sobriety, honesty and good welding knowledge and in a surprisingly short time mould such an individual to his design. The alert shop owner will in turn learn many new operations and methods from the competent operators he is forced to hire. If the shop can afford a helper or apprentice he will be a good investment if properly chosen, as he will naturally conform to the system and practices under which he is trained. A badly chosen personnel in the modern job shop will soon drive both customers and profits from the door, while on the other hand a skilled and courteous welding operator is invaluable to any job shop.

Welding applications are developing so rapidly that thoroughly qualified operators are at a premium. It is true that welding schools throughout the country are turning out graduates with every degree of training. Most of these graduates, however, have merely learned the rudiments of their trade. To the job shop operator with a flare for teaching, this is a new field of profit that he can explore with both

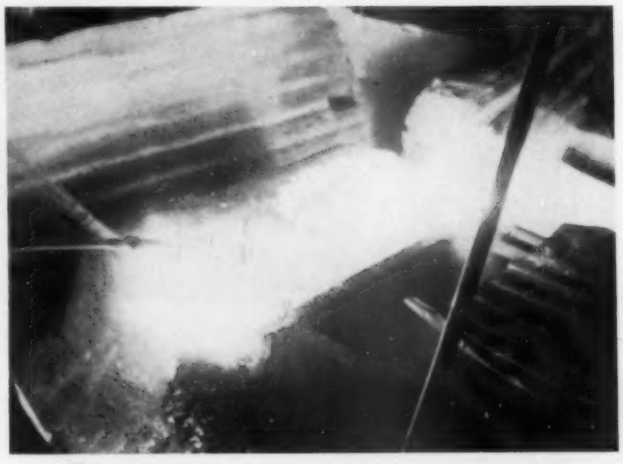

Fig. 3—The start of oxy-acetylene welding. Note use of carbon blocks to hold contour of dovetail design. Photo (Airco).

Fig. 4—Here is how the cast-iron hammer base looked after welding was completed. Photo (Airco).

benefit to himself and to the industry. There are many graduate students of welding who would be glad of the opportunity to learn advanced welding in a job shop under competent tutelage, and will pay for the privilege. Many of the "home town boys" who can afford a reasonable tuition fee cannot afford to maintain themselves away from home, while learning to weld and would quickly avail themselves of an opportunity to learn at home.

Members of the structural steel workers organization see "the hand writing on the wall" and really want to learn arc welding at night, or between jobs so that they will be in a position to carry on in their chosen field. The job shop operator who goes in for this kind of work need add no additional equipment. He can confine his enrollment to the number of students his shop will accommodate and do his teaching at night so that it will not interfere with his regular business. This involves little additional overhead and secures maximum service from equipment.

Keep Accurate Records

The average commercial job shop is hardly large enough to employ the services of a bookkeeper, so it usually falls to the proprietor or his wife to keep accurate records of the business. For this same reason a complicated set of books is neither necessary nor desirable. A day book covering every transaction, including cash received and paid out, and all charge accounts, should be kept handy at all times. It is an easy matter when busy to neglect putting down a transaction, and that one item may mean the difference between profit and loss on the day's business. If materials are bought on open account, a purchase ledger should be kept so that invoices can be checked against it each month; otherwise you may pay for something you have never received.

These daily transactions should be transferred to a ledger and all accounts receivable and payable posted up to date. An itemized sheet of disbursements can also be kept; breaking them up into material costs, advertising, rent, insurance, etc. Thus, at the end of the year a complete picture of expenditures will be at hand, which will greatly aid in filing an income tax report. Another essential record to keep in a job shop is a gas tank book. This should show the number and receiving date of each oxygen and acetylene tank and also the date it was returned empty. This may save considerable embarrassment in cost of loss of a cylinder and will many times save demurrage charges that do not rightfully belong to the shop. By balancing the books each month the owner knows exactly where he stands and can take steps to correct any wrong practice that may be interfering with the making of a legitimate profit.

The welding industry has moved so rapidly in the past few years that it would be fool-hardy to hazard a guess as to its future. That it is destined to be one of the great tools of the future is conceded even by laymen. What part the old type of job shop will play is easier to forecast. Each year, for the past several years, the job shop operator has had many of his old standard "props" kicked out from under him. The equipment salesman has not only increased his competition many times, but has taken his customers away with the same stroke. There will always be small repairs to be made. But, the job shop owner who wants to get back "into the money" must not operate a repair shop alone—he must become a welding contractor in the full sense of the word. If he can survive this period of stagnation and ruthless competition, he will be, through ownership of equipment and necessary experience, the most logical heir to the pipe-fitter and steel worker on all welding jobs in his community. In that direction will be found the profits for the job shop of the future.

» «

Rebuilding of Worn Gears Is a Profitable Specialty

By ROBERT LATIMER

★ Replacement of worn, broken, or twisted gears with an efficient process developed by Herman Flader, president of the National Welding Co., Denver, Colo., has been a steady business builder for more than 20 years. Customers are drawn from many different types of western industry, including mining, contracting, farming, and other trades in the Rocky Mountain region.

Heavy gears are refaced to order,

Rebuilding of gears such as these has been a steady business builder for National Welding Co., Denver, Colo.

replacing lost teeth, or worn sections, with a guarantee of ten times as long a life as that of the original casting. Some of these gears, brought in by contractors, are badly worn, others are broken and twisted from heavy strains. The broken or damaged section is first ground out and cleaned with a hand grinding wheel and buffed smooth. The next step is preheating with a gas flame, or in a gas furnace, according to the size of gear. Tool steel, cut to size, is used to fill in the ruined rim section, and is arc welded to the rim. From 2 to 20 teeth at a time are replaced. They are hardened by the regular process of heating in a gas furnace to the required temperature, and quenching in "fish" oil. The secret of making good repair, according to Mr. Flader, is to determine the exact hardness of the gear, and match it perfectly with the replacement units. Renewal teeth are first machined to size and then hardened.

Because of the difficulty of carburizing a large gear, the Flader process is particularly valuable, resulting in a gear with a soft, resilient base, and giving a combination of toughness and durability, with little danger of breakage. All types of gears are refaced by this company, bevel gears, small transmission gears, and spiral types. Newest of the specialties, and one which promises to be an important field, is hardening the dipper teeth of shovels. Several of these teeth, fitted with overlays of high-carbon steel and heat treated to the desired degree of hardness, have been the means of saving one mountain contractor thousands of dollars annually.

Costs for this type of refacing are less than half of the original cost of the gear when new. As an added guarantee of the quality of his work, Mr. Flader asks the customer to forego payment until the gear (or other machinery) has been in use for some time. This insures customer satisfaction.

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Welding Has Come of Age— A Review of Technical Advances

By J. C. JOUBLANC*

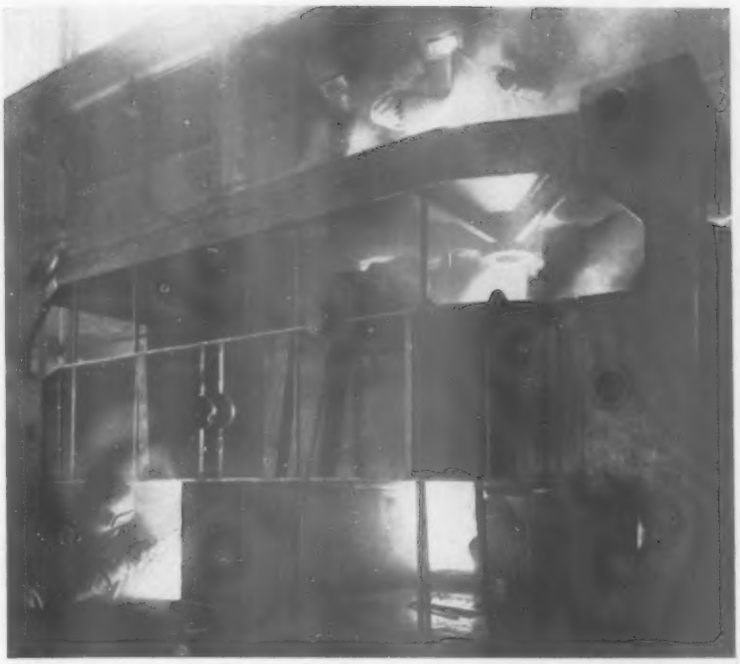
★ If we define welding as a method of joining two metal sections so as to form a homogeneous mass, our story must begin with the blacksmith who heated bars or rods to the point of incipient fusion and then by applying pressure joined them together to form a continuous length. Many of the phases in the development of metal joining processes have overlapped each other in their order of introduction. For instance, several methods of percussion welding, such as hammer welding and roll welding, were introduced within relatively recent years, although the principles underlying these processes are very like those employed by the blacksmith.

Spot welding, butt, seam, and lap welding are modifications of the percussion method of joining, although these employ electric resistance as a source of heat. These processes are plastic joining—where the metal is brought to a sufficiently high temperature and joined by application of pressure. They usually require large mechanical installations and are not as flexible as those requiring actual fusion of the metal without the application of pressure. This latter classification further divides itself into: gas welding, electric arc welding, and thermit welding.

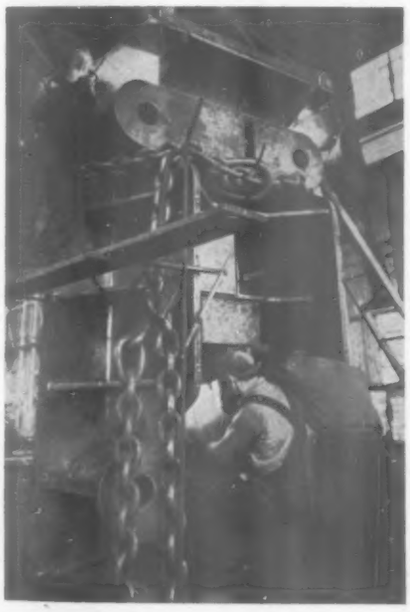
While the applications of thermit welding are limited, it offers the possibility of a higher uniform and homogeneous bond between two metal sections. Its chief application lies in repair work on large castings and in joining rail sections. It makes use of the high temperature attained by the thermo-chemical reaction between iron oxide and powdered aluminum. The process is essentially as follows—a suitable mold is built around the members to be joined, and a crucible placed above it containing the proper thermit mixture. When the work is ready, the mixture is ignited and the iron oxide reacts with the powdered aluminum resulting in the reduction of the oxide to the metallic state, forming an aluminum oxide slag which floats on the

*Chief Metallurgist, Harnischfeger Corp., Milwaukee, Wis.

Automatic welding head for circular work. Note that head uses straight electrodes. Photo (Harnischfeger Corp.).



A group of welders at work on a structure which will form a part of the power press shown below. Photo (Harnischfeger Corp.).



Four arc welders busy at work on a huge 24,000 lb. die to be used in a giant power press. Photo (Harnischfeger Corp.).

surface of the highly superheated metal. The reaction requires a little less than a minute for completion. When a complete separation of metal and slag has taken place, the crucible is tapped from the bottom and the metal allowed to flow into the mold. Because of the extremely high temperature of the metal at the time it comes in contact with the sections to be joined, complete fusion results and upon solidification the weld has much the appearance of a casting.

Torch welding marked the first important step in the development of a process which was both flexible and economical. Torch welding is still the most valuable tool where low melting-point alloys are used as the filler metal.

The history of electric arc welding begins with experiments conducted on electric arc behavior during the first half of the 19th century. Davy and Artus investigated the possibility of utilizing the electric arc for welding purposes. In 1842, the carbon arc flame was suggested for soldering. In 1880, two Russian scientists, Bernados and Slavianoff, experimented with a carbon arc, obtaining patents in 1884-1885.

The metallic arc process, however, was not developed until 1889 when fundamental patents were granted to Coffin in Detroit and Dr. Zerener of Berlin, Germany. In this country, by 1902, Baldwin Locomotive Works began to seriously investigate welding possibilities, but it was not until 1910, when Gray & Davies attempted to weld small generator frames, that an actual commercial application took place. Further commercial development was exceedingly slow. But the terrific demands of the last World War for iron and steel products furnished the impetus necessary toward developing this efficient method of metal fabrication.

The first metallic electrodes were simply bare rods regarded more as a source of welding heat than as an integral part of the metallic bond. As electric arc welding spread, more attention was paid to the mechanical properties of welded structures. To assure perfect fusion of the members forming the structure, the plates had to be "veed" or scarfed out. With such set-ups, the electrode used formed an important part of the welded structure and the analysis of the wire used had to be considered.

Considerable experimentation determined that wire having a carbon content as low as .02% was the best suited for welding purposes because the arc sputtered less than with high-carbon wire. But it was found that welding was faster when the carbon content of the wire was around .20%. A compromise was made between a low-carbon wire which gave a relatively stable arc and a high-carbon wire which permitted higher welding speed.

But bare wire welds could scarcely be regarded as homogeneous bonds between the sections to be welded as oxygen in the atmosphere of the arc reacts at the metal surface to form iron

Two arc welders are fabricating a gantry crane girder. Hoist is used as a welding positioner. Photo (Harnischfeger Corp.).

A 100,000-bbl. welded Hortonspheroid at a refinery near Beaumont, Texas. It is 141 ft. 6 in. in diameter by 40 ft. high. Designed to withstand an internal pressure of 15 psi. For storage of volatile liquids. Photo (Chicago Bridge & Iron Co.).

A group of welded gasoline storage tanks at a pipeline terminal at Kansas City, Kans. All tanks equipped with Wiggins Pontoon Roofs. Photo (Chicago Bridge & Iron Co.).

oxide. This is soluble in molten metal, destroying resistance to corrosion and has marked effects on physical properties.

In considering technical refinements, the problem divides itself into (1) physics of the arc, (2) physico-chemical and metallurgical problems involved in the melting-cooling cycle during welding. There is still much to be learned about the physics of the arc, but we do know that the arc behavior is influenced largely by gases and solids present in the ambient atmosphere.

The requirements for the proper analysis of electrodes were then fairly well established, together with the fact that welding characteristics could be greatly improved by a light mineral coating. The production of this lightly-coated wire having certain chemical properties was important toward developing shielded arc electrodes. However, analysis of weld metal and arc stability were not sole factors in the production of sound welds, and the nitrogen and oxygen absorbed by the weld metal still existed in dangerous proportions. It was found that if the coatings contained combustible matter, much of the oxygen which would otherwise be absorbed by the metal would be used up in the process of combustion of these organic substances.

It was recognized that to produce sound welds it was essential that the molten metal be protected at all times from whatever gases existed in the atmosphere of the arc, resulting in the present day shielded arc electrode.

The All-Important Slag

The modern process of electrode coating is essentially the super-imposing, on the proper type of rod, of a combination mineral and organic paste by means of extrusion at very high pressures. The rod with this coating is subsequently dried at a definite rate under very carefully controlled conditions. During the process of welding, the organic materials burn, forming the necessary gaseous shielding, and the mineral part of the coating melts to form a slag which covers the molten pool, flowing about an eighth of an inch behind the arc. Any slag-forming substance capable of melting at the temperature of molten iron may afford the necessary protection against the absorption of deleterious gases, but there are many factors to be considered in the selection of proper coating materials so that the slag in the molten state will have the proper (1) viscosity, (2) surface tension, (3) stability.

(1) As to the first, the slag must neither be too fluid nor too thick; if too fluid, slag will tend to run ahead of the arc, resulting in undercutting in fillet welding: If too thick, uniform solidification is impeded, resulting in depressions in the weld surface.

(2) The surface tension of the slag may be said to be the ability of the molten slag "to wet" with the molten metal.

(3) The slag should be stable, that is, it should not be easily dissociated into compounds which might later diffuse into the molten metal.

Added to these, any effective coating, in its use in conjunction with mild steel, must contain some deoxidizing ferro-alloy to prevent formation of gaseous inclusions or blow holes. Considered in its entirety, welding with a heavily-coated electrode presents somewhat the same problem as does steel making with regard to retention in suspension of harmful non-metallic inclusions. During the brief period in which the metal is molten, the inclusions which always form must be of such a nature as to be easily expelled.

An attempt has been made to trace the development of welding from the crude methods employed by the blacksmith to our present highly technical and highly specialized methods of metal fabrication. Emphasis has been laid on metallic arc welding. Some of the welding theory has been discussed in detail to acquaint the reader with the many factors that enter into the production of sound welds. With the proper concept of good welding technique and the fundamentals involved in production of sound welds, welding is no longer viewed as merely a means of bridging a gap between two metal sections, but as the production of a homogeneous bond between them.

» «

Stainless steel doughnut fryers are arc welded. Photo (Westinghouse).

Brief Sketches of Welding Jobs

Speedy Spot Welding By Home Made "Gun"

By CHARLES F. BERRY

★ A welding device, which reduces time required for certain spot welding operations by 80%, is the invention of Delmar Gray, a San Francisco model maker. This home-made welder resembles an automatic pistol in size and shape. A squeeze grip in the handle clamps the points down on the wires to be fused, thus eliminating a helper. The current is turned on by squeezing the trigger.

Gun type welder for spot welding of heavy copper wire framework.

The pistol welder was designed particularly to spot weld the heavy copper wires that form the skeleton framework of life-sized mechanical dummies constructed in the Delmar Gray studios. Operated by one hand it may be used either inside or outside the framework. A speed of 20 welds per min. is said to be possible with this gun welder, as against 4 or 5 welds with ordinary equipment. Although the gun is comparatively light it is balanced on a weighted pulley so that it needs no support during its operation.

» «

Thermit Welded Rails Used By Des Moines Street Railway

By R. D. KIMMEL

★ The use of thermit welds-made-under-traffic has been the accepted standard of the Des Moines Railway Co., Des Moines, Iowa, since 1931. Over 6000 welds have been made on 74 miles of paved car tracks, to replace bolted joints. The rail sizes vary from the 70 lb. ASCE rail to the 150/512 9-in. rail. The most popular size is the 7-in.

One gang of men welding under traffic (with exception of severe winter weather), can average from 6 to 15 completed welds in an 8-hr. day. This means digging out the paving, shimming the replaced piece, welding and repaving. In most cases, the battered end is cut back a distance of from 4 to 10 ft. and a new piece of rail inserted. This process entails two welds, but has been found to be more satisfactory.

(Top) Excess metal is chipped off while the weld is still hot. (Bottom) Pouring the hot thermit metal (pure molten iron) into the mold built around the pre-heated rail ends. Photo (R. D. Kimmel).

The cost of thermit welding over bolted rail ends figures about the same, $12 per joint. But the increased life of wheels and rolling stock causes the thermit welded joints to be greatly preferred.

» «

Bronze Welding Joins 42-In. Steel Pipe to 42-In. Cast-Iron Pipe

★ Engineers of the City Water Dept. of Racine, Wis., had the problem of joining together a large steel pipe to a cast-iron water main. Wall thickness of the steel pipe was ⅜ in. and of the cast-iron pipe, 1½ in.

The weld was completed by two welders in 6 hrs., and when tested it was found to be thoroughly sound. The cast-iron pipe was very dirty, having been in service for some time, but after the scale was removed, it was found that the CIG No. 401 Ready-Fluxed manganese bronze welding rod worked satisfactorily.

A charcoal fire was built on the inside of the cast-iron pipe to preheat to approximately 400 deg. F. The bronze weld was started from the bottom. One man worked on each side, and the weld was completed at the top without any cracks developing in the weld.

Robert Gordon, Inc., of Chicago, Ill., was the contractor on this pipe job.

» «

Welded Handwheel For Oil Well Control

By M. E. PATE

★ When high pressures within an oil well demanded a large handwheel on the main control gate, it was decided to remove this control from within the well enclosure. At the same time it made it possible to provide sufficient leverage for the flowing of the well to be within the power of one man.

The usual universal joint was used between original gate valve stem and the joint of heavy 2½-in. drill stem used for the extension. A handwheel of the usual cast iron type was considered, but the cost was found to be too high.

To provide a substitute for the cast iron wheel the welder took a length of one-inch pipe, and formed it to a circle 28 in. in diameter by the common "wrinkle-bend" method. The wrinkles thus formed on the inside of the circle provided a firm hand-grip for the well switcher. The center cross was also built up of one-inch pipe, and is welded directly to the end of the extension pipe. To complete the job, a one-inch cover strap was carried over the extension piece and welded to the vertical supporting post.

Bronze welding the junction of 42-in. steel pipe to 42-in. cast-iron main. Close-up of welded joint shown at left.

Brief Sketches of Welding Jobs

Spotting Weakness In "Air Bottle" Design

By ELTON STERRETT

★ To cushion the hammer of pump strokes in an 8-in. all-welded pipeline carrying crude oil under an initial pressure of 900 psi., each pump discharge line at the station was equipped with an "air bottle" or air-cushioning device similar to the one shown in Fig. 1. These were formed from pipe and charged with high pressure air before being put on the line.

At the outset these bottles seemed to serve the purpose admirably, then began to develop small leaks which stubbornly refused to stay welded, no matter how carefully the repair was carried out. All the breaks came at the point *X* of bottle *A* in Fig. 2, and even the addition of a bead measuring nearly the initial pipe wall thickness failed to make a pressure-tight seal that would stand up.

The bottles were formed from 12 in. pipe, both ends being shaped with a torch in order to weld in the usual orange peel form of closure. At the bottom, the tip of this welded section was omitted to accommodate a short 6-in. nipple, which was welded into the truncated cone thus formed. As originally made, the base section required approximately 92 in. of weld, the juncture between base of bottle and nipple coming at a sharp angle, despite all attempts to make a serviceable fillet weld.

When the bottles in service continued to fail at the one circumferential weld (marked X), it was not until a sketch similar to *B* in Fig. 2 was drawn up, that the men in authority would concede that the breaks might be due to localized stresses. The bottle tended to stretch slightly and then resume its original length 171 times per min., thus being subjected to 246,240 alternations of stress every 24 hrs.

As a means of getting away from the weld at *X* a 12 in. x 6 in. swage coupling was secured, and welded in to form the base of a new bottle. (See *B* in Fig. 2.) With the swage to take care of the reduction in diameter from bottle to pipeline size, a smooth, doubly-curved surface was presented to absorb the frequent alternations in stress. The single weld in the base with this design is at the top of the swage where the load is carried in direct tension.

The total length of weld to form the base of this revised design of air bottle was only 38.5 in. There was an additional saving of acetylene and oxygen formerly consumed in making the outline for the orange peel base.

As each of the bottles made on the earlier design showed signs of failure, they were replaced with those incorporating the swage, and the pipeline company has yet to report the first failure of a swage-bottomed air chamber. Several of the new type have already doubled the working life of the former design. This pipeline's trouble is but another example of how welding is mistakenly held to be at fault, when the blame really should be laid on the design, or on the designer's lack of understanding of stress localization and what that means under fatique loading.

» «

Brazing Copper Conductor Arms with Silver Alloy

★ Low-temperature silver brazing alloys are being used by Sperry Products, Inc., in building rail welding equipment. The current conductor arms, an important part of this welder, are made of copper bars ¼ in. thick by 6 in. wide. They are brazed to a copper casting with "Easy-Flo" brazing alloy containing a medium percentage of silver, which flows freely at 1175 deg. F. This alloy was selected for this application for four important reasons:

(1) It makes joints which are ductile and high in tensile strength. (2) The electrical conductivity of the joints is as high as or higher than the copper itself. (3) Joints of solid metal cannot oxidize and never require cleaning or servicing. (4) The free flowing silver brazing alloy goes into the joint, little stays outside, little or no finishing work is needed.

The finished joints. Note sharply defined, clean joints and that the thin film of brazing alloy can hardly be seen. Photo (Handy & Harman)

The conductor arms on this job are inserted in slots, ¾ in. deep, milled in the copper castings. A low-temperature flux was used which is fluid and active at 1100 deg. F.

The rail welder, a recent development by Sperry Products, Inc., joins railroad rails permanently into long lengths. Rails of standard 39-ft. length have been welded to form lengths of 1700 ft. and these lengths in turn have been welded together. The longest stretch now in service measures 7700 ft. and is located near Schenectady, N. Y.

» «

Flame-Descaling a Steel Casting

★ This operator is flame-descaling an 18,000-lb. steel casting for a hydraulic turbine. Flame-descaling is a relatively new process for removing scale from blooms, billets, slabs, forgings and steel castings by means of specially designed oxy-acetylene heating heads. The process is based on the principle that when high-temperature quick heating is applied to the scale (or oxide skin) on a piece of cold metal, the scale expands and breaks away from the base metal, because of differential expansion between scale and steel. Descaling has a number of advantages over other cleaning methods such as

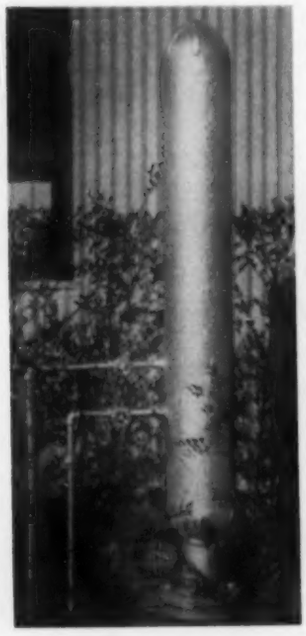
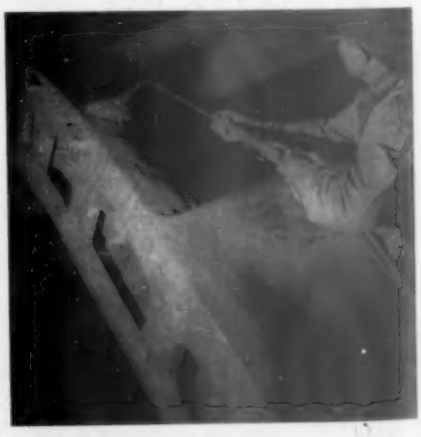


Fig. 1 — Welded "air bottle" for cushioning pump hammer in an 8-in. crude oil pipeline.

Fig. 2—Where failure repeatedly occurred in "orange peel" design (X) and how this concentration of stress was avoided in newer design by welding in a swage coupling (S).



Flame-descaling a big steel casting for a hydraulic turbine. Photo (Linde Air Products Co.).

pickling, sand-blasting, and chipping. The casting shown here, for example, was flame-descaled in one-fifth the time formerly required for chipping.

» «

Welded Manifolds for Pump Lift at Hayfield, Calif.

By MAYNARD M. SHUCK

★ The Hayfield pump lift job, on which I was employed, is 36 miles east of Indio, Calif., in the middle of the rattlesnake and cactus country. This welding job was not a cinch or a picnic. All welders were certified by the Metropolitan Water District of Southern California. Test welds were subjected to the free-bend test and 50,000 lb. straight pull. Squirming around on rocks in wet ditches to escape the sparks that just seem to find the bare skin, regardless of leather protection, we had to plaster the hot rod as tightly overhead as we did in any other position. We used Lincoln Fleetweld 5/32 in. and 3/16 in., making four passes outside and two inside.

At Hayfield there are two manifolds, one is for pumping water directly off the open canal, and the other is for drawing from the Hayfield 86,500 acre-foot reservoir in case of a breakdown in the line between that junction and Parker Dam. The combined five pump lifts installed at varying distances along the aqueduct comprise the world's greatest pumping system. Hayfield station is the only junction where two manifolds are installed. Both of these vessels are 16 ft. in diameter at the greatest width and 6 ft. at their minimum width.

A "stiff leg" crane lowered the segments into the ditch where they were welded into place. No leaks were found in either of the two manifolds at the time of hydrostatic testing. This is a very good record considering the amount of welded butt seams.

The mammoth Metropolitan Aqueduct, with its total 392 miles of tunnels, siphons, canals and steel pipes, taps the treacherous Colorado River, 155 miles below Boulder Dam in a convenient narrow rock canyon.

Welding on the upper manifold at Hayfield, Calif. At the right is wall of pump house.

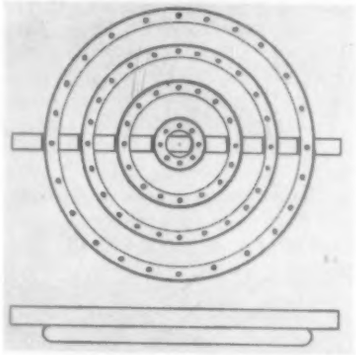
Redesign of Welded Burner Saves Production Time

By ELTON STERRETT

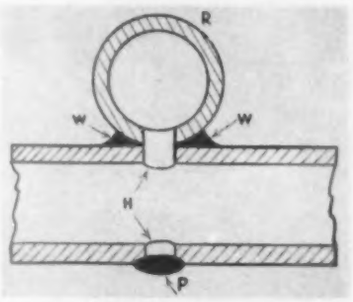
★ Because a welder looked beyond his blueprint and welding orders, the production time on a built-up burner was cut 35% at the welder's stand and even more on the drill press. The initial scheme called for the concentric rings of the burner to be drilled at opposite diametral points with a quarter-inch drill. Corresponding holes were drilled in the transverse feeder tube and these were to be matched up (supposedly) by the welder as the tubes were joined.

Since the rings were made from coiled seamless tubing, and welded into continuous rings as an initial operation, there was little slack to permit accurate registry of holes when the welder built up the assembly. Much time and effort was lost attempting to match the small gas leads and maintain concentricity of the rings.

At the welder's suggestion a set of rings was assembled, pinholes downward, and a feeder tube, likewise not drilled, was placed across them in the proper spot. The assembly was then welded as far as possible in this position, then reversed and the bead run the remainder of the way around each junction of ring and feeder. This welded unit was then taken to the drill press, and the ¼-in. connecting holes drilled entirely through the feeder from the bottom, ending within the circular ring. This operation, performed on a rigid unit, could be quickly and accurately performed by the drill press operator.



Plan and elevation of built-up borner, showing rings welded on top of feeder pipe.



Detail of junction between burner ring and feeder pipe, showing drilled port and plug closing lower hole. (R) Burner ring. (W) Junction welds. (H) Connecting hole, drilled after welding junction. (P) Plug welded into lower hole in feeder pipe.

Following the drilling, the burner unit was returned to the welder and a plug was welded across the hole in the bottom of the feeder tube.

Using this welder's plan, the concentric rings could be jig assembled and the feeder piece tied into place without time lost in attempting to register the series of eight holes. By the former method these holes had to match within fairly close limits or else an unevenly burning burner would result. Likewise, the connecting hole between ring and feeder being drilled after welding, left no change of the orifice being sealed or partially clogged with molten metal, as sometimes happened when following the former method.

The burner rings, originally formed singly, were cut from tubing coiled to the diameters of the various rings, one round from each coil forming a ring. This coiled section needed merely to be cut off and butt welded to complete the ring.

» «

Mississippi River Barges Repaired By Arc-Welding

By JAY WILLIAMS*

★ A welding repair job which attracted considerable interest was recently completed at the Baton Rouge, La., plant of The Mengel Co., one of the largest manufacturers of plywood and lumber in the South and East.

Situated on the east bank of the Mississippi River a few miles north of Baton Rouge, the Mengel plant depends largely on the river for transporting its logs. Used in this transportation are five steel barges, built a number of years ago of riveted design. Years of severe service have taken their toll on these barges, and it recently became necessary to do something about leaky rivets and rotting deck plates.

Serious consideration was given to the idea of sending the barges to New Orleans, La., or other points where contract shops with docking facilities could replace the leaking rivets. This would have greatly impaired operation at the Baton Rouge mill, due to the fact that it was almost imperative that four of the barges remain in service at all times.

*Sales Engineer, National Cylinder Gas Co., New Orleans, La.

Fig. 1—Welding up rivet heads in a deck plate.

It was Harry Roberts, plant engineer, who came to the rescue with a plan born of long experience with welding and cutting. Roberts decided they could solve their problems by welding, instead of replacing, the rivets, and by replacing defective deck plates with new steel. He studied the various bids submitted by contract shops for replacing the rivets, then gave his estimate of what he thought it would cost them to repair the barges themselves. His estimate showed a saving of between $3000 and $4000. Naturally he got the okay to go ahead.

The barges, one of which measures 140 ft. long by 34 ft. wide by 8 ft. deep, and the other four, measuring 160 ft. by 40 ft. by 8 ft., contained a total of approximately 47,000 rivets. Taking one barge at a time, Russell Leonard, the welder, using a 300 amp motor-generator arc welder and General Electric W-22E and W-23 electrodes, was able to weld an average of 400 rivet heads per 8-hr. day.

All defective deck plates were cut out with oxy-acetylene torches and replaced with new 5/16 in. steel plates, which were welded in place. Figure 1 shows Mr. Leonard welding up rivet heads in a deck plate.

A tarpaulin-covered all-welded "doghouse" was used to protect the arc welder and electrodes. This structure is light and portable and was used by Mr. Leonard on exceptionally hot days to protect himself from the sun while welding on the deck plates. Scaffolds were used while welding the side- and end-sheets.

The barges are towed by Mengel's steamboat "Seminole," a stern-wheeler drawing only 3½ ft. of water. With a shallow draft, she is able to navigate many of the tributaries of the Mississippi which otherwise would be hazardous. In her quest for timber to feed the hungry Mengel plant, the "Seminole," with her barges in tow, steams as far as 400 miles up river.

» «

Flame-Harden 16 Tractor Sprockets at One Time

★ Sixteen sprockets gang-hardened at a time! That's how one manufacturer has solved a knotty production problem of flame-hardening the teeth of rear drive sprockets for tractors.

The trick in doing this work successfully is to make sure that the nested parts are clamped tightly together, since any space between the parts would result in a non-uniform case. In this instance, the 16 sprockets, supported by an arbor, are drawn together by taking up on the nut, as shown in the illustration.

Each of the sprockets is 26⅛ in. in diameter, has 27 teeth, and is made of S.A.E. 1045 steel. Hardening is performed with two 2 D.P.* gear-hardening heads, each attached to an Oxweld W-26 blowpipe. The unit is driven by an Oxweld CM-8 cutting machine. A speed of 7 in. per min. produces a ⅛-in. to 3/16-in. depth of case; with hardness of flame-treated surface raised to 70 Scleroscope.

The nested sprockets are inclined at an angle of 8 deg., thus permitting quench water to escape more readily from around the heating flames.

*Diametral pitch.

Tractor sprockets are flame-hardened, 16 at one time. Sprockets are supported on an arbor and clamped tightly together. Photo (Linde Air Products Co.).

Welded "T" Beams Replace Wooden Decking Supports

★ When it was found necessary, for public safety, to replace the wood decking supports of a bridge, the highway engineer of Miami County, Ohio, called for arc welding. Eight 12 in. stringers of standard "I" beams were welded, using a Hobart 200-amp. gasoline

Bridge reconstruction work is expedited by means of arc welding.

engine driven arc welder. Eight gallons of gasoline and 50 lbs. of Hobart No. 55—3/16 in. shielded electrodes were used to complete the job in 7 hrs. It is stated that a net profit of $19.75 was realized by the welding operator. Officials were pleased with the speed and economy of the strengthening and repair work. Plans are now being made for rebuilding by welding, other bridges throughout the county.

» «

Welded Steel Sheathing Applied To Decks of Wooden Barges

★ A new departure in barge construction which already has received approval of waterway shippers, has been developed by Reliance Marine Transportation and Construction Corp. and the Ashley Welding Machine & Iron Co., Inc., both of Kingston, N. Y. The innovation consists of laying lap-welded steel sheathing over the decks of the "boxes" to prevent chemical action of the cargoes carried from rotting the wood decking. Seven barges of the Reliance fleet of 18 boats already have been equipped in this manner. This is believed to be the first time

Cabins were covered with 14 gauge sheet iron all welded. All deck plate was lap welded.

Coaming angles ready to be installed. Note the "bitt" mounted on ½ in. reinforcement plate, with welded bolt head.

that electric welding has been combined with wood barge construction.

Reliance officials discovered that chemical cargoes carried in their boats in the New York State Barge Canal caused the decks and other exposed woodwork to become spongy. Towing bitts turned in the softened wood and considerable loss was occasioned by leakage. Through application of steel sheathing over the decks, these difficulties have been surmounted, and in addition, insurance rates on cargoes carried have been decreased.

The seven barges already equipped range from 750 to 1,000 tons capacity. Covering the decks of each boat required nearly 9 tons of steel and approximately 1,000 lineal ft. of welding by the Ashley firm.

Reliance workmen first removed the old, spongy decking and wooden rails. After the deck had been smoothed off, felt was laid over the deck boards for insulation. Then prefabricated 3/16-in. steel plates were bolted through the decks and were lap-welded to 9-in by 7-in. angles mounted over the edges of the decks and extending down the sides. Coaming angles for the hatches were lap-welded to the sheet steel plates.

Every precaution was taken to make the decks watertight. Towing bitts were mounted on a ½ in. reinforcement plate and bolted through the deck, with the bolts set in oakum and lead. All bolts extending through the deck were welded. Canvas hatch covers were fastened to a wire running through angle irons clip-welded to the coaming pieces. Cabins were covered with 14 gauge iron, all welded. New wooden rails were supported on Z-irons which were welded to the deck plating. Asbestos paper was laid under all joints to prevent the felt from burning during the welding process.

» «

New Procedure Suggested For Welding Stainless Steel

★ The Composite Steel Division of Jessop Steel Co., 627 Green St., Washington, Pa., has recently developed a new method of welding stainless-clad steel that is said to eliminate any reduction in corrosion resistance in the weld zone. In the past, some difficulty has been reported in welding stainless-clad steel, due to the admixture of mild steel with stainless steel in the weld zone.

The new method of welding stainless-clad steel maintains full corrosion resistance of the weld zone, even when a mild steel rod is used for welding the backing. Figure 1 is an unretouched photograph (top and cross-sectional view) of a piece of welded "Silver-Ply," a stainless-clad steel manufactured by Jessop Steel Co. This test piece had been subjected to a 24-hr. exposure of a 20% salt spray mist. It will be noted from top view, that there is no more corrosion in the weld zone than in adjacent parts.

Figure 2 illustrates the procedure for welding stainless-clad steel by the new method. Fig. 2A shows the plate as supplied, the cross-hatched portion representing the cladding. The plate is then scarfed and the cladding bent down with a follow-up tool or hammer, as illustrated in Fig. 2B. The primary weld (bead No. 1—Fig. 2C) is made with a ⅛-in. stainless steel coated rod at the juncture of the two claddings. The two plates are then turned over and secondary welds made on the underside of exposed cladding, as indicated in Fig. 2D, using a 3/16-in. stainless steel coated rod. The final weld (joining the mild steel backing) may be made with a ¼-in. mild steel coated rod. Figure 2E represents the completed weld; bead No. 1 is then ground flat with the cladding.

In all cases where stainless rods are used, the rod should be richer in alloy than the cladding. Lowest possible amperage and fastest possible welding speed are recommended.

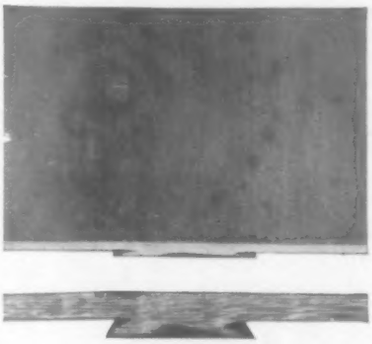


Fig. 1—(Top) Top view showing cladding on piece of welded stainless-clad steel, which has been subjected to salt spray test. (Bottom) Cross sectional view of same piece.

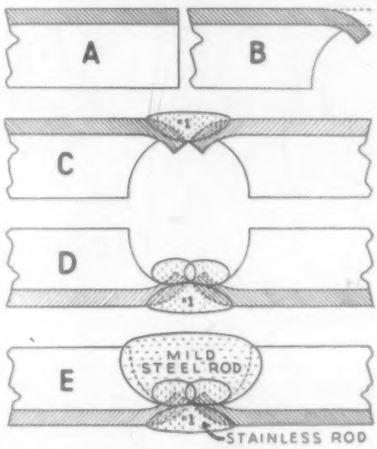


Fig. 2—Steps in new method of welding stainless-clad steel.

» «

Simple Changeover From Steel Rims to Pneumatic Tires

By S. S. BREWER

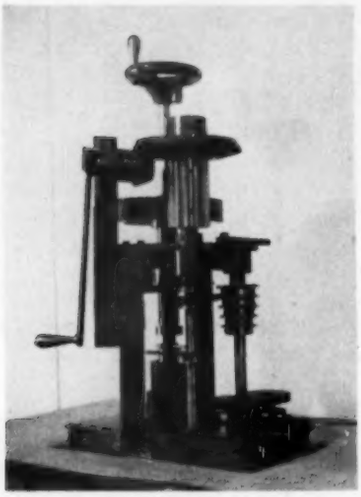
★ An illustration shows a changeover from steel rims to pneumatic tires on a farm-mowing machine. This is a profitable job that may be done by any welder, as the only tools required are a hack saw, a steel rule or tape and a welding set, oxy-acetylene or electric. We used a 450 x 21 tire, rim and fellow on this job.

This farm mowing machine was changed over from steel rims to pneumatic tires by a simple welding operation.

The wood spokes were first removed, then the mower wheel was cut down to fit into the pressed steel fellow, and arc welded to it. Tire and rim were then bolted on. This rebuilt machine works great on rough fields and has plenty of traction. Welding enables the farmer to bring his old machine up to date at small cost.

After being formed from pure nickel sheet, this "over-boiling ring" for a brew kettle dome was assembled in this jig and then welded.

New Product Developments



Laboratory extrusion machine for experimental coating of welding rods.

Laboratory Extrusion Machine

★ Foote Mineral Co., 1609 Summer St., Philadelphia, Pa., announces a laboratory extrusion machine which can be used in experimental development work in coating welding rods. This type of machine is similar to ones which are now used by welding rod manufacturers. Foote Mineral Co. states that this type of machine is used in their own laboratory for coating not only mild steel electrodes, but also stainless steel, manganese steel and aluminum electrodes.

» «

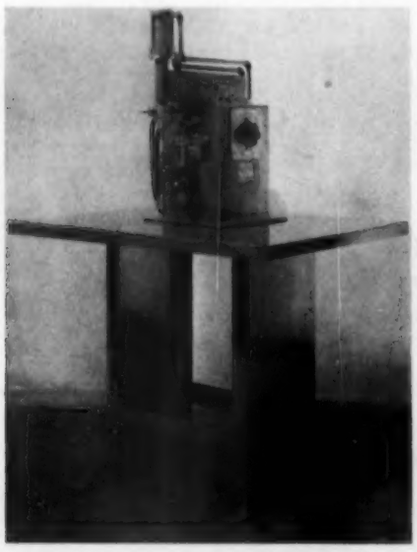
Eisler Vertical Type Spot Welders

★ Eisler Engineering Co., Newark, N. J., has recently developed a complete line of vertical type spot welders. Extreme accuracy in the spot welding of parts used in manufacture of typewriters, adding machines, clocks, check-writers, safety razors, precision toys, etc., is obtained by the plunger action of the upper electrode of the vertical machine. Where most accurate results are desired, these machines are supplied timers and contactors.

Ranging in size from ½ k.v.a. to 500 k.v.a., these machines are supplied in foot, air, or power-operated models, depending on the class of service. Either branch or pedestal models are available. Bench models can be supplied with steel tables if desired.

These machines are especially adaptable where studs and lugs are to be accurately welded to sheet metal without drilling of holes. A typical application is their use in welding electrodes to spark plug shells. It is essential that the welding operation be precisely performed. A suitable fixture, together with vertical action of the upper electrode accomplishes the desired result.

Six points of heat regulation are obtainable with the dial control, mounted on the side of the fabricated case. These machines are said to be easy to operate, economical in operation, and to require practically no maintenance.



Vertical type spot welder for precision work.

» «

Remote-control relay, motor and drive assembly.

Remote Control Saves Arc Welding Time

★ Welding current may be regulated without interrupting work or even breaking the arc through the use of the recently developed Glenn-Roberts remote-control system.

Available for all industrial models of Glenn-Roberts welders, the new remote-control operates through a compact switch mounted on the electrode holder. A low-voltage relay circuit operated by the electrode holder switch controls a reversible motor, which in turn operates the full-range "stepless" Glenn-Roberts heat control. By thus giving the operator constant, "finger-tip" control of welding heat, interruptions are avoided and quality of welding is improved. At all times the operator can provide exactly the heat each type of rod or welding job requires. Operator's efficiency is increased (especially on structural or large-scale fabrication jobs where welding is done at considerable distance from the welding sets) because welding current changes may be made without interrupting work.

Model 35 G-R a-c. welder with remote-control unit mounted on top.

Six of the seven models of transformer-type welders manufactured by Glenn-Roberts Co., Inc., Oakland, Calif., are available with the new remote-control system. Sizes range from the 20 to 125 amp. unit up to the heavy-duty industrial models with maximum output of 1250 amp. The latter are designed for either single or multi-circuit manual operation, or as a current source for automatic welding heads.

» «

Owen Electric Has New Transformer Type A-C. Welder

★ Owen Electric Mfg. Co. of Fayetteville, N. C., has developed a new oscillating current transformer type electric welding machine. Features claimed for these machines are—high efficiency, high power factor and ease of operation; combined with good welding qualities on ferrous and non-ferrous metals.

The following data was obtained from the 20 to 400 amp., 220/440-volt machine, operating at 220 volts:

Idling current — 1.3 amp. — 121 watts — power factor 42.3%.

Arc Amps. at 40 Volts	Efficiency	Power Factor
50	95.3	98.0
150	92.8	97.0
300	90.5	100.0
375	90.5	100.0
410	89.7	98.4
445	91.0	94.4

New Owen a-c. type welder possesses several operating advantages.

The Owen machine will accommodate all types of electrodes used commercially with both a-c. and d-c. equipment, particularly electrodes made for use with d-c. welders.

Open-circuit voltages of 65 and 90 are fixed. The stepless range of machine at 65 volts is from 20 to 445 amp. Any desired setting is obtained by turning hand wheel attached to movable reactor core. Approximate weight—850 lbs.

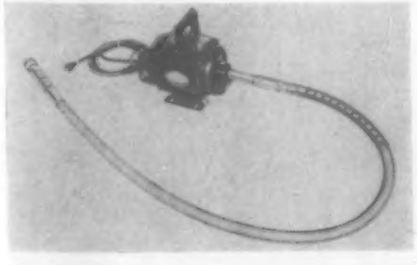
High efficiency, high power factor and high welding qualities are said to result from the electrical system which utilizes inductively, oil-filled condensers, in both primary and secondary circuits. These condensers are automatically thrown in and out. The Owen system is available on a license basis.

» «

Combination Flexible-Shaft Machine

★ Expansion of the Stow "Junior" line of flexible-shaft units to include a combination tool, has been announced by Stow Mfg. Co., Binghamton, N. Y. This new Model AJ machine consists of motor, flexible shaft, clamp spindle and extension cord and plug. The new units are being introduced at lower prices, as the result of standardization of design and manufacturing economies.

The combination model is for both bench and portable use, being fitted with conventional base and also with carrying handle. With its compactness and light weight, the tool can be operated in close quarters. Its principal application is for grinding, light drilling, polishing, sanding and filing operations. The same attachments are available as furnished for Stow heavy-duty machines.



Stow Model AJ flexible-shaft unit.

Miller A-C Welder Has Dial Type Control

★ An entirely new design in a-c. welders is announced by Miller Electric Mfg. Co., Appleton, Wis. The amperage, voltage and reactance control are all in one dial, placed at an angle and at the right height on the front of the cabinet so that the operator can change the dial without stooping to see the amperage markings. When he selects the amperage desired, the voltage and reactance change automatically. Welding leads are easily detachable. The all-steel case is arc welded and designed to furnish adequate ventilation without an open top, so that no metal parts, dirt, tools, or water can get into the electric wiring. The finish is durable baked-on enamel. The transformer is of heavy-duty type with air-cooled coils. It holds its rated output regardless of temperature. Built in four models to meet requirements, 165, 200, 250, and 300 amp., each welder comes completely equipped with 20 ft. of welding leads, headshield, electrode holder, clamp type ground and an assortment of welding electrodes.

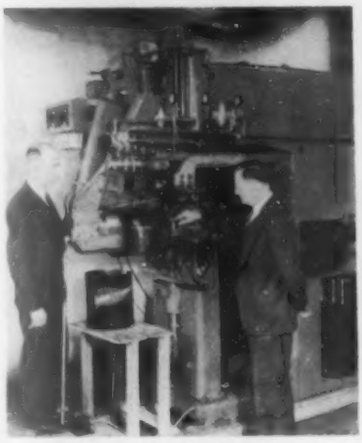
New Miller a-c. welder has simple amperage control.

» «

"National" Paint Pail Welder

★ Illustrated is one of the recent developments of National Electric Welding Machines Co., Bay City, Mich. This is a special high production paint pail welder, especially designed for seam welding of the side seams of 3, 5, and 7 gal. paint pails. Equipment is entirely automatic, with exception of loading.

Rolled shells are fed to the operator's position by means of a conveyor. The operator merely "picks up" the shell and easily and quickly wraps it around the lower horn, into a gauge block, that automatically determines the lap. He then steps on the foot-operated switch which automatically makes the first tack (spot) weld, and the shell then feeds into the continuously revolving seam welding rolls, and is pulled through the rolls, while the remaining tack (spot) welds are made holding the lap. The spot welds are made "on the fly" and are controlled by photo-electric cells. The seam welded shells fall into the machine's throat onto an unloading conveyor. This special equipment was designed to seam weld paint pails after the lithographing has been applied.



Automatic spot and seam welder for paint pails.

» «

Low-Temperature Brazing Torch

★ Victor Equipment Co., San Francisco, Calif., is now producing, among other welding and cutting equipments, specially-designed torches to meet the increasing demands for various types of low-temperature brazing operations. The torch here illustrated operates on the Bunsen burner principle and may be provided with tips to utilize acetylene or other usable fuel gases. This multi-head brazing torch illustrates but one of several designs adaptable for specific operations, where two or more flames, suitably arranged, facilitate low-temperature brazing of circular or irregularly-shaped objects.

Special brazing torch for low-temperature alloys.

News of the Industry

NATIONAL SAFETY CONGRESS—An army estimated to be 10,000 strong invaded Atlantic City, N. J., recently. But this army, recruited from all parts of the world, was fighting to protect life instead of destroy it. The safety forces were mobilized October 16 for the 28th annual National Safety Congress, a five-day "council of war." From every corner of the United States, and from some foreign countries, delegates assembled for this great safety convention.

The keynote of the 1939 Congress was the assertion that safety now can be obtained in any quantity by anyone or any organization that wants it—just as groceries or other products may be obtained. "Any city or state or industry has the power to determine its own death rate."

Personals

F. A. FARON, manager of the New Haven office, and E. G. DUDLEY of the industrial department, New York District, of the General Electric Co. have been named assistant managers of the industrial department of the New York District. The appointments became effective October 1.

» «

B. H. LAWRENCE, formerly chief engineer, has been elected vice-president in charge of engineering, United States Steel Corp. of Delaware, and a member of its executive committee and board of directors. With the exception of three years immediately following his graduation from college, Mr. Lawrence has been connected with United States Steel subsidiaries during his entire engineering career. He has served in executive engineering capacities in the Chicago, Ill., Worcester, Mass., and Cleveland, Ohio districts, and has been chief engineer of United States Steel Corp. of Delaware since January 1, 1938.

» «

WILLARD A. TERRY, for several years associated with the welding section of General Electric's Industrial Department in Schenectady, N. Y., has been assigned to new duties in the company's Philadelphia office, according to an announcement by L. D. MEEKER, manager of G-E electric welding sales. In his new position, Mr. Terry will have charge of electric welding sales along the Atlantic seaboard, including the heavy industrial centers of Philadelphia, Norfolk, and Pittsburgh. C. I. MACGUFFIE, arc welding specialist in the Atlantic district, will take over Mr. Terry's duties in the Industrial Department at Schenectady.

» «

GENERAL ELECTRIC PUBLICITY APPOINTMENTS—Three assistants to the manager of the General Electric publicity department were appointed recently. W. V. MERRIHUE was named in charge of apparatus division, R. L. GIBSON in charge of general publicity division, and B. J. ROWAN in charge of administrative and production division.

W. V. MERRIHUE is a native of Martin's Creek, Pa., and was graduated from the University of Pennsylvania in 1925. He immediately started work in the publicity department of General Electric, and in 1930 was named assistant manager of the industrial advertising section. He was appointed division manager of central station advertising in 1933.

R. L. GIBSON was graduated from Park College, Missouri, in 1925 with an A.B. degree. He entered General Electric the same year to do market research work. In 1926 he was transferred to the Philadelphia office as publicity representative and in 1928 was granted a leave of absence to become public relations director of Lafayette College. He returned to the company in 1929 to take charge of district office publicity contacts. He was named manager of the newly organized market research division of the publicity department in 1932, and in 1936 was appointed division manager of industrial advertising and sales promotion.

B. J. ROWAN entered the testing department of Pittsfield, Mass., works of the company in 1918. In the same year he entered military service, at the conclusion of which he rejoined General Electric, and in 1919 entered Boston University, from which he was graduated in 1922. Following graduation he entered the business training course of the company at Schenectady. He was transferred to the publicity department the following year and in 1925 was named executive assistant to the manager of the Denver, Colo., office of the company. Since 1930 he has been district manager of the publicity department in New York City.

This heavy rock crusher base was fabricated by welding. Photo (Airco).

» «

H. H. SIMMONS, advertising manager of Crane Co., has been promoted to manager of advertising and sales promotion, succeeding RUSSELL G. CREVISTON, who assumes a new position, director of trade relations. In addition to directing advertising Mr. Simmons will supervise the company's related sales services: sales promotion, catalogs, displays and exhibits, two Crane magazines, and publicity.

Arc welding a section of an emergency compression chamber used in the construction of the State Street Subway in Chicago. Photo (Western Welding & Boiler Repair Co.).

Low Fuming Welding Rods

ANACONDA 997 (Low Fuming) Welding Rod — high strength, tough weld metal with low fuming characteristics—has been added to the extensive line of Anaconda copper alloy welding rods. It is widely used for the general oxy-acetylene repair-welding of cast and malleable iron, steel and copper . . . It is particularly valuable where repairs must be made quickly and easily on machinery parts, automobile engine blocks and similar equipment. Anaconda 997 Welding Rod is manufactured under United States Patents Re 17,631 and 1,525,058. Available from supply houses handling Tobin Bronze and other Anaconda Welding Rods.

THE AMERICAN BRASS COMPANY

General Offices: WATERBURY, CONNECTICUT • *Offices and Agencies in Principal Cities*

In Canada ANACONDA AMERICAN BRASS LTD., New Toronto, Ontario

ANACONDA

Anaconda Welding Rods

A.W.S. Activities

NEW YORK SECTION, A.W.S.—At its meeting September 12, 1939, the subject of "Selection and Application of High Temperature Piping Material" was presented by E. H. KRIEG and G. SONDERMAN, both of the engineering department, American Gas & Electric Service Corp. This was a joint meeting with the New York Chapter of American Society for Metals. EDWIN B. RICKETTS, mechanical engineer of Consolidated Edison Co., New York City, was chairman of the meeting.

» «

PHILADELPHIA SECTION, A.W.S.—At its meeting of October 16, the Section was addressed by E. H. KRIEG of the engineering department, American Gas & Electric Service Corp. His subject was "Arc Welding Carbon-Molybdenum and Other Steel Pipe."

» «

ST. LOUIS SECTION, A.W.S.—The development and acceptance of arc-welded design of steel structures built by the Upper Mississippi Valley Division of the U. S. Army Engineers Corps was the subject of the meeting held October 13 at the Engineer's Club, 4359 Lindell Blvd. HOWARD E. BOATH and CHARLES F. MACNISH, both of the U. S. Army Engineer Corps presented the paper.

» «

DETROIT SECTION, A.W.S.—"The Romance of Spot Welding," presented by A. E. HACKETT and LOUIS M. BENKERT, both of Progressive Welder Co., was the subject of the October 6 meeting held in the Colonial Room of the Detroit-Leland Hotel. Included in the program was a Bureau of Mines motion picture, "Modern Metalworking with the Oxy-Acetylene Flame."

» «

PITTSBURGH SECTION, A.W.S.—"Welding Problems in Stainless Steels." was the subject of a paper by VIRGIL WHITMER, metallurgical department of Republic Steel Corp., at the October 18 meeting, held in the auditorium of the Mellon Institute of Industrial Research. At the same meeting HOWARD L. MILLER, metallurgical department, Republic Steel Corp., presented a paper "Welding of Low-Alloy High-Tensile Steels in Transportation Equipment."

Trade News

G. E. ORDERS UP 31%—Orders received by General Electric Co. during the third quarter of 1938 amounted to $79,510,000, compared with $60,533,000 during the same quarter last year, an increase of 31%. For the first 9 mos. this year orders received amounted to $248,582,000, an increase of 32% over the $188,757,000 received during the same period a year ago.

» «

CHANGE OF ADDRESS—Effective October 5, the General Publicity Department of the following units of Union Carbide and Carbon Corp., has been moved from 205 E. 42nd St. to 30 E. 42nd St., New York City: The Linde Air Products Co., The Oxweld Railroad Service Co., Carbide and Carbon Chemicals Corp., Union Carbide Co., Electro-Metallurgical Co., and Haynes Stellite Co.

» «

THE TAYLOR-WINFIELD CORP. has opened a sales office in Room 623, 340 Main St., Worcester, Mass., with V. WAYNE GREEN in charge. This office will handle sales of the Taylor-Winfield resistance welding equipment in the New England territory.

» «

GLENN-ROBERTS CO., INC., Oakland, Calif., manufacturers of the G-R a-c. remote control type arc welder announces the appointment of the following West Coast distributors: (1) H. A. CHEEVER Co., Seattle, Wash., (2) INDUSTRIAL SPECIALTY Co., Portland, Oregon. The latter firm also has an export division located at 7 Front St., San Francisco, Calif.

» «

STULZ-SICKLES Co., 134 Lafayette St., Newark, N. J., has recently appointed the Weld-All Equipment Co., P. O. Box 5891, Cleveland, Ohio, as distributor of Manganal Bare and Tite Kote Welding Electrodes, Manganal Wedge Bars, Applicator Bars, Hot Rolled Plate, etc.

» «

STAINLESS STEEL, in its multitude of uses, will be featured in a striking manner in the exhibit of United States Steel Corp. subsidiaries in spaces 76 and 77 at the Exposition of Chemical Industries to be held December 4-9 at the Grand Central Palace, New York City. Applications, products, finishes, and properties will be stressed. Additional displays will show the application and properties of Lumnite Cement in the chemical industries, while a special display will be devoted to Duroline pipe.

» «

DYMONHARD CORPORATION OF AMERICA, 30 Rockefeller Plaza, New York City, manufacturers of Dymonhard hard-facings, announces appointment to its engineering and sales staffs of Major H. A. HALLETT and F. J. GIROUX, as sales engineers. Major Hallett incidentally is well known in the field of aviation. Mr. Giroux has held a number of important positions in the welding industry.

Construction

NORTHERN NATURAL GAS Co., Omaha, Nebr., has started work on the construction of a 240-mile 16-in. welded natural gas pipeline to extend from a point near Sioux City, Ia., to a point near Minneapolis, Minn. This is the largest gas line under construction at this time. Contractors on the line are C. S. Foreman Co., Monarch Construction Co., and Truman-Smith Construction Co. The line is scheduled to be completed some time in November.

» «

THE RIO GRANDE GAS & POWER Co. will soon construct a welded pipeline through the county of Sutten, Texas, to supply the city of Sonora with natural gas.

» «

CIMARRON VALLEY PIPE LINE Co., a subsidiary of Champlin Refining Co., has started construction on a 280-mile extension of its welded gasoline pipeline system. The new line will run from its terminal at Superior, Nebr., to a point near Sioux City, Ia.

» «

NATIONAL TUBE Co. has been awarded a contract for 38,000 tons of steel pipe to be used in construction of the new 438-mile welded oil pipeline to be built by Utah Oil Refining Co., subsidiary of Standard Oil Co. of Indiana.

» «

MAGNOLIA PIPE LINE Co. has a welded gasoline pipeline under construction, 226 miles in length, and extending from Kilgore, Texas to the company's refinery at Beaumont on the Gulf Coast. It will be mainly a four-inch line, and will parallel the existing crude oil line. Construction contractors on the project are T. R. Jones Inc., of Dallas, Texas, and Sheehan Pipe Line Construction Co., of Tulsa, Okla.

» «

WILLIAMS BROS. CORP., pipeline contractors, has been awarded a contract by the Texas Pipe Line Co. for construction of a 42-mile 8-in. welded pipeline to run from West Columbus (Tex.) to Webster, where it will connect with the company's main line to Texas City.

Recent Patents

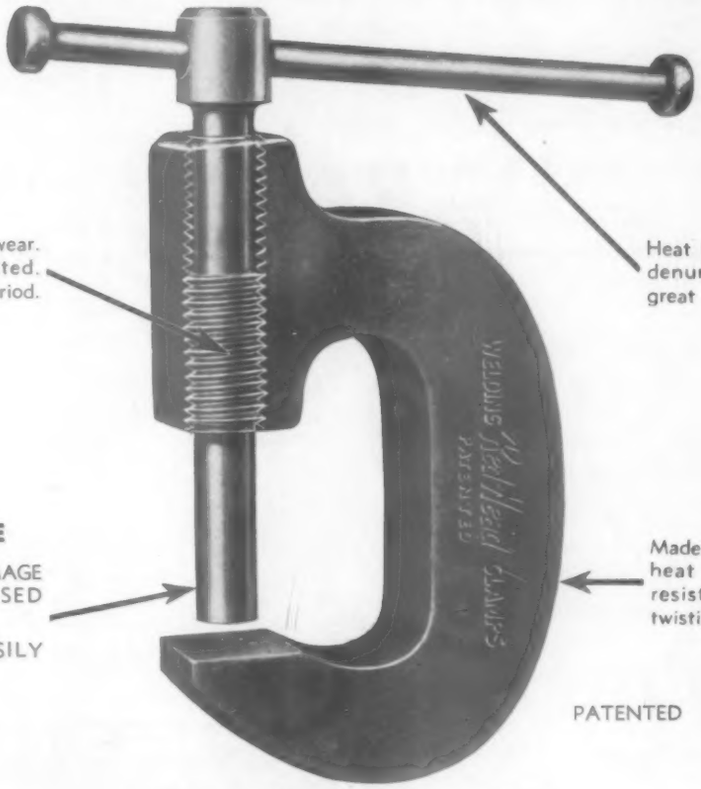
WELDING COATED METAL PARTS

2,170,019. THOMAS S. GAYLORD, Rochester, N. Y. Filed Aug. 11, 1937. Issued Aug. 22, 1939. This invention is concerned with the welding of metal parts or sheets having a protective layer or coating. In the welding of such parts, such as in the case of galvanized parts, or parts coated to prevent corrosion, the protective layer may be injured by the heat required to melt the weld rod. According to the patent, at the time of welding, a reconditioning or refilling of the regions adjacent to the welded seam which have been deteriorated during the welding operation, is carried out. In the process a weld strip is employed which has a coating of protective metal to replace that destroyed on the welded parts. This method has been applied successfully to joining ferrous parts or sheets, such as iron or steel parts or sheets which have been covered with a protective layer of zinc, nickel, chromium, or copper. One of the outstanding uses is for joining iron sheets with a galvanized or galvannealed zinc protective coating. Corrosion resistant metals which may be employed on the weld rod are tin, chromium, nickel, antimony, silver, cadmium, zinc, and bismuth. The basic rod is dipped into the molten coating metal. Other suitable process of coating welding rods are obviously also applicable. The weld rod core may vary, although rods of copper alloy are preferred, such as one containing 60% to 98% copper. A highly

"Red Head"

WELDING CLAMPS

Withstands All Welding and Handling Abuses


Heat treated for long wear. Threads always protected. Retains oil for long period.
Heat treated chrome molybdenum alloy handle offers great resistance to bending.
MAIN FEATURE
NO THREADS TO DAMAGE IN OPEN OR CLOSED POSITION.
WELD SPATTER EASILY REMOVED.
Made from solid steel plate, heat treated, giving great resistance to bending or twisting.
PATENTED

14 STOCK SIZES

SPECIAL SIZES AND SHAPES FURNISHED FOR SPECIAL APPLICATIONS

INDESTRUCTIBLE CONCEALED THREADS

Red Head Welding Clamps have been especially designed for welding service. Their construction eliminates the trouble caused by weld spatter or accidental damage to threads. A clamp that will stand up under the most rigorous service over long periods of time.

Territories Open for Jobbers

CHICAGO BOILER COMPANY

1965 Clybourn Avenue **Chicago, Illinois**

A trial will convince you. Send for sizes and prices today.

CHICAGO BOILER COMPANY
1965 Clybourn Ave., Chicago, Ill.

Please send specifications and prices on Red Head Welding Clamps.

Name .....

Address .....

City ..... State .....

REGISTERED U.S. MANGANAL PATENT OFFICE

NEW! TITE-KOTE WELDING ELECTRODE
for A. C. Welding

This newly-introduced electrode for A.C. welding is identical with the regular bare MANGANAL electrode, except that it possesses a *SPECIAL SELF-PEELING COATING that in no way retards the quick cooling of the weld deposit.*

Welds made with this new electrode possess the same ductility and toughness possessed by deposits made with MANGANAL bare electrodes.

Available in 1/4, 3/16, 5/32 and 1/8 in. sizes (14 in. length). Packed in 50-lb. containers.

Write for name of nearest Manganal distributor

STULZ-SICKLES CO. Sole Producers 91 N. J. Railroad Avenue, NEWARK, N. J.

Manufacturers of MANGANAL Manganese Nickel Steel WEDGE and APPLICATOR BARS, Hot Rolled PLATES, etc.

satisfactory rod has 94.4% copper, 4.5% silica, and 1.1% manganese. An arc welder of 75 amp. capacity is suitable for welding with such a rod.

» «

WELDING BLOWPIPE

2,170,793. CHARLES F. CARROLL, London, England. Filed April 23, 1936. Issued Aug. 29, 1939. The inventor describes a torch so constructed that the proper mixture of an inflammable gas and oxygen will always be obtained at the nozzle without the necessity of constant manipulation of control valves and the like. The torch delivers a constant predetermined flow pressure of gases to the nozzle irrespective of changes in pressures in the supply lines due to the consumption of the gases or to other causes. Proper control is obtained by automatic pressure valves arranged in the gas passages. In addition there are elements in the gas passages intermediate to the control valves and the nozzle for regulating the flow of gas and oxygen supplied to the nozzle. With such a torch, there is no need for visual inspection of the flame by experienced operators. Such inspection is ordinarily a continual necessity where control means are not supplied, it is stated.

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WELDING SHIELD

2,171,052. LOUIS G. TATTER, Chicago, Ill. Filed Jan. 28, 1938. Issued Aug. 29, 1939. A welding shield having a framed window of colored or shaded glass to protect the eyes, is provided with means for moving the glass to give an area of clear vision, through clear glass, when it is desired to momentarily inspect the work. The movement of the glass is electrically controlled, preferably by a push-button, or other switch, on the tool or electrode holder with which the welding is being done. This arrangement obviates the necessity of using one hand to manually open the window, when the area of vision is needed. The amount of clear area may be varied as desired.

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FLUX FOR MAGNESIUM WELDING

2,171,041. JOSEF M. MICHEL, Bitterfeld, Germany, assigned to Magnesium Development Corp. of Delaware. Filed Feb. 6, 1937. Issued Aug. 29, 1939. The welding of magnesium or magnesium alloys customarily involves the use of a flux containing, as a substantial constituent, halides and more particularly chlorides or bromides of these metals. The use of such halides as are not volatile at the welding temperature, is intended to prevent the energetic oxidation of the magnesium which occurs at welding temperatures, or to absorb any oxygen compounds nevertheless formed, by the melting halides, so as to enable an intimate and secure union of the welded surfaces to be obtained. However, with this process traces of the halide containing flux become trapped or included in the metal and in course of time give rise to efflorescence of the welds and, subsequently also to decomposition of the magnesium. The invention prevents this by converting any traces of the flux which may become included in the metal and other such traces as cannot be removed from the seat of the weld (for example, by rinsing or the like), into a harmless form.

» «

WELDING ROD

2,171,306. GLENN V. IRELAND, Wauwatosa, Wis. Filed Oct. 17, 1936. Issued Aug. 29, 1939. Welding of cast-iron or other relatively soft metal parts which can be machined, and which will be free from checks and cracks, is the object of this patent. The inventor points out that in the welding of metals such as cast-iron, the usual results have been deposits so hard they could not be machined. In addition, such welds frequently cracked. These results are attributed to the formation of a layer of hard white iron during the cooling operation. Moreover, the white iron, being hard and brittle, is extremely difficult to machine. Such white iron formation can be inhibited, according to this patent, by minimizing the amount of carbon in the coating materials and the binder of the rod. For example, a clear, quick drying lacquer of the type used in coating iron, when used as a binder, produces a soft deposit, whereas the use of a lacquer colored black by carbon pigment, or where rosin, finely divided coal, or charcoal, and the like, are used in the coating, a deposit of extremely hard and brittle material results. Preferably, the new rod is wrought iron or other low carbon steel. The rods are coated with a suitable composition which includes essentially the compounds of boron, iron, and

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sodium held by a non-carbonaceous binder. One or more de-oxidizing agents are also added. Such agents are ferro-silicon, phosphor-copper, magnesium, aluminum, ferro-titanium, and boron alloys.

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WELDING THIN SHEET ENDS

2,172,080-1. JAMES E. FAY, Middletown, and ED REED, Zanesville, Ohio, assigned to The American Rolling Mill Co., of Ohio. Filed March 24, 1937. Issued Sept. 5, 1939. These patents are concerned with the special problems connected with the welding of thin sheet metal parts. Such problems involve the butting of the sheet ends with an absolutely perfect conformation of the two ends, control of heat, and protection of the metal from extraneous influences such as oxidation. To secure a good weld, the inventors clamp the sheets near the butted ends and keep the temperature of the clamping means even throughout their length to avoid distortion of the sheet ends due to temperature differentials. The heat is applied by a torch which rides on the butt ends, thereby insuring a regular weld even if the butt ends have irregularities in thickness. Magnetically-operated clamping devices are employed to control the clamping pressure and effective width of clamping means. The process is applicable to sheet metal ranging from 22 gauge to 30 gauge or thinner. The patents cover not only the process, but also apparatus for carrying out the process.

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WELDING PIPE JOINTS

2,173,109. CLYDE M. HAMBLIN, Washington, D. C. Filed Feb. 8, 1938. Issued Sept. 19, 1939. Government patent. To prevent the formation of projections inside tubes or pipes during welding the ends thereof, a dam or stop is provided inside the tube ends, which dam can be removed after the welding operation is completed. The dam consists of a circular ring or cylinder of non-metallic, fire-resistant and heat-resistant material such as magesia block which will soften or disintegrate in water, or of material such as diatomaceous silica or baked sand which will crush easily. The ends of the tubes to be welded are forced over the ends of the stops meeting at the center of the stop. After welding the stop may be removed by disintegration in water forced through the pipe, or by some form of pipe cleaner, depending upon nature of stop used. Where galvanized pipe is to be welded, zinc foil or sheet may be wrapped around the welding stop. During welding the zinc forms a coating on the interior of the welded pipes.

Current Reviews

ELECTROLYTIC OXYGEN-HYDROGEN PLANTS —The Underwriters' Laboratories, Inc. have published a bulletin known as Research Bulletin No. 10, entitled "Electrolytic Oxygen and Hydrogen Plants and Their Operation." This 36-page bulletin is very complete. It contains an introduction which indicates the function that the Underwriters' Laboratories, Inc. have been called upon to perform in connection with certain problems of standardization. It discusses the need of standards. The uses and methods of distribution of oxygen and hydrogen are briefly noted in a general reference to distribution of the products of this industry. Electrolytic plants and their equipment, the operation of electrolytic plants and the proper maintenance of all necessary equipment forms the principal subject of this bulletin. Anyone interested in electrolytic plants can obtain a copy of this bulletin by writing to the Underwriters' Laboratories, Inc., 207 East Ohio St., Chicago, Ill.

» «

APPLIED ECONOMICS FOR ENGINEERS—Executives in industry have repeatedly pointed out that the technical graduate is handicapped by a lack of training in the practical principles of economics and technical educators are beginning to realize the truth of this claim. One difficulty has been that most prescribed courses in economic theories are not applicable to present conditions in a practical way. Based on this need, John Wiley & Sons, Inc., New York City, have just published "Applied Economics for Engineers," by Bernard Lester.

In this book the author emphasized the importance to the student of forming the habit of referring to current technical and industrial journals. A large number of such references have been used.

Though this book is primarily a text book for engineering students, there are a large number of recent technical graduates and engineers engaged in strictly technical work to whom it may be of direct interest. A large number of welding illustrations are included.

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OXY-ACETYLENE WELDING FOR BEGINNERS—This text by J. W. Giachino was prepared especially for the beginning student of oxy-acetylene welding, and covers the technique from the simplest to the most advanced operations. It contains 24 lessons, each accompanied by a brief, clear explanation of needed apparatus, safeguards, use of tools, and methods of procedure, followed by questions which clinch the information presented in the lesson. One lesson is devoted to the identification of metals used in welding—a matter of great importance to the welder. A welding check card enables both instructor and student to keep an accurate record of progress being made. The last lesson contains instructions for making 17 attractive projects, including andirons, log grate, fireplace screen, service table, smoking stand, etc. 71 illustrations, $1.48. Published by The Manual Arts Press, Peoria, Ill.

» «

NEW GENERAL ELECTRIC ARC WELDING MANUAL

A pocket-size arc welding manual, containing over 180 pages of useful information for welding operators, has just been published by General Electric Co. Reviewing the chapter headings the new manual covers: (1) Technique of arc welding, (2) Practical applications of arc welding, (3) Automatic arc welding, (4) Atomic hydrogen arc welding, (5) Training course for operators, and (6) Arc welding equipment. An outstanding feature of the new G-E manual is the chapter on atomic hydrogen arc welding, which in addition to describing the equipment and operating technique refers to its use in the repairing of tools and dies. This process is commonly used for such repairs. The chapter on "Training Course For Operators" consists of 15 practical lessons in welding for the guidance of potential operators.

Advantages pointed out for the atomic hydrogen process are: (1) Metal of the same analysis as the die block can be deposited, (2) Heat treating properties of the weld-deposited metal are the same as those of other parts of the die, (3) It produces an unusually smooth ductile deposit free from pinholes or impurities, (4) Thickness of deposit can be varied easily from the thinnest surfacing up to a heavy deposit. Feather edges can be built up without adding excess metal. Procedure for this work is detailed and it is noted that "best results will be obtained by having hardened die annealed before welding."

In the appendix at the back of the book will be found a series of engineering data tables of interest to welding men and also a handy estimator for determining the amount of arc welding electrodes required for various types and sizes of joints. With the aid of these tables, the estimator can figure pretty closely how many pounds of welding electrodes will be required per lineal foot of weld. Price of the new manual is $1.00, postpaid.

Trade Literature

THE INDEPENDENT PNEUMATIC TOOL CO., 600 W. Jackson Blvd., Chicago, has recently put a new 5½ in., 17 oz., rotary air grinder on the market. Complete data and specifications of this new THOR tool are covered in a newly-issued circular (P.20). All grinding wheels and accessories available are pictured and priced to give an idea of versatility of this tool.

» «

NEW WELDING PICTORIAL—Condensed pictorial presentation of interesting welding, punching and riveting ideas and applications is the basis of a new house organ, the first issue of which has just been released by PROGRESSIVE WELDER CO., 737 Piquette Ave., Detroit, Mich. Designed to provide helpful suggestions to engineers and production executives, the "Welding and Punching Pictorial" is to be issued on a monthly basis. Copies of the current "Welding and Punching Pictorial" are available, without charge, by writing to the company direct.

Classified Section

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FOR SALE—Welding cable, rubber covered, mill ends, like new super-flexible type. No. 2 at 18c; No. 1 at 20c; No. 1/0 at 26c; No. 2/0 at 30c. Pierce governor $17.50, Metallizer gun $100. Address O-6, The Welding Engineer.

BARGAINS—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Hobart Welder Exchange, Box U-1091, Troy, Ohio.

FOR SALE—Acetylene Welding Equipment, $35.95 to $73.75. Easy payment plan. Superior Oxy-Acetylene Machine Co., Hamilton, Ohio.

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WELDER—2 yrs. exp. welding school graduate. Will take job as helper if it will lead to promotion. Age 43. Arthur La Berge, 807 Third Ave., N., Park Falls, Wis.

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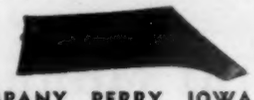

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